JULY 1964 35 CENTS ICD

SCIENCE DIGEST

HOW RELIGION HELPS TO HEAL

WHAT DOCTORS & CLERGY REPORT

NEW COPTER

AT THE FAIR

A COMPUTER TELLS WHO STARTED WORLD WAR I

DO YOU NEED 8 HOURS SLEEP?

For conventions—piggyback TV

THIS month's Republican convention at San Francisco and next month's Democratic meeting at Atlantic City will be two of the most thoroughly "covered" events in history.

There will be so much TV equipment in and around the convention halls that spectators, reporters and delegates alike may be in danger of strangulation in the hundreds of thousands of feet of camera cable.

The National Broadcasting System will try to hold down the cable clutter, and get the jump on other networks, by giving their viewers close-up shots taken by a new camera with its own transmitting system. NBC refers to the system as a "walking TV station" (above).

This equipment, used for the first time at the conventions, combines a small TV camera and a microwave transmitter in a lightweight pack unit.

When the system is in operation, TV pictures made by the camera are beamed several hundred feet to a microwave receiver.

The camera, which is equipped with a zoom-type lens for closeups, is supported by a lightweight metal harness which the cameraman wears around his waist. The camera is mounted on a metal linkage so that it can be raised above crowds and held there.

From the camera the picture signal moves over a cable to the microwave transmitter. A vertical antenna radiates the signal.

Cameramen carrying the "portable TV stations" will work with NBC's four floor reporters at the convention.

Because of such advances, TV viewers may know more about what is going on at the conventions than spectators in the convention hall—or even the delegates themselves.

SCIENCE DIGEST

Twenty-eighth year of publication

Something old and something new at the New York World's Fair. A model of Tyrannosaurus Rex stares up at Sikorsky's new amphibious helicopter as it takes visitors on a tour over the fairgrounds. The story of S-61N starts on page 53.

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ARTICLES

FEATURES

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Fluoridation dispute

I am surprised and chagrined at your inclusion of John Lear's article "Documenting the Case Against Fluoridation" in your March '64 issue. I believe you owe it to your readers to present another article in reply to Lear.

Lear's original *Saturday Review* articles were disputed by Peter C. Goulding, director of the American Dental Assn. Bureau of Public Information, who stated:

"John Lear based his attack on fluoridation on his own interpretation of a single published paper. Mr. Lear gives no evidence of familiarity with the orginal studies reviewed in the paper. He ignores the reviews of the subject by the National Research Council (National Academy of Science), the American Medical Assn. and other highly qualified groups.

"He certainly gives no evidence of familiarity with the several thousand reports of original studies which provide the details for understanding

the safety and effectiveness of fluoridation.

"I believe that even the authors of that one published paper—Mr. Marier, Dr. Rose and Dr. Boulet—would not support the manner in which Mr. Lear has presented their original comments.

"Their paper is simply a review of a small part of the scientific literature dealing with both high and low levels of fluorides; it does not represent any new research, and it does not draw conclusions opposed to fluoridation—contrary to the implications in Mr. Lear's article."

It is my great interest in the value of your magazine that has prompted me to write.

WALTER C. KRAATZ, PH.D.
Akron, Ohio

I was surprised to discover that *Science Digest* reprinted John Lear's article. An editorial in *McLeans* magazine pointed out several things about the Canadian report used by Lear.

"John Marier, one of the authors of the report, stated, 'Our paper was not an attack of fluoridation. I myself have been giving my son fluoride in milk—and he has no cavities after six years. We were suggesting areas in which research was needed to clear up a doubtful point.'

"One section of the Canadian paper Lear did not quote was its opening statement:

"'Enough research has been done to show conclusively that low levels of fluorides in water reduce dental caries. . . . The fluoride concentration recommended for artificial fluoridation is below the level at which ill effects appear. . . . Osteosclerosis (hardening of the bones) was not

detected in areas with less fluoride than four parts per million in the water supply.'"

By your action, you have presented the anti-fluoridationists with further "evidence" to support this case—in other words, printing this article in a "scientific" publication would seem to imply your acceptance of the "documentation" provided by Lear.

J. STEWART CALVERT
Chairman of Science
Northmount Jr. High School
Willowdale, Ont., Canada

We found the articles on fluoridation to be most interesting and we think a very valuable public service.

ERNEST R. ANDERSON, President
Greater New York Committee
Opposed to Fluoridation, Inc.
New York, N.Y.

Science Digest should be commended highly for doing what few national publications do—allowing both sides of the fluoridation controversy to air their views openly and fairly.

MRS. MARY ACCORNESO
Richmond, Calif.

I was delighted that you presented both sides of the fluoridation issue. There are a large number of M.D.'s and dentists who are opposed to fluoridation and think there are safer ways of limiting tooth decay. In our family, we have noticed a marked reduction since we have given up sweets.

JEAN E. MITCHELL
Sioux City, Iowa

One of the most foolish aspects of the fluoridation situation is that nobody seems to consider that hundreds of millions of gallons of water are consumed for purposes other than drinking. Why should we spend thousands of dollars on such foolishness. I think it's rather pointless to fluoridate the water that's used for these other and far larger consumption purposes. Our taxes are too high now.

J. E. WUBBOLKY
Cincinnati, Ohio

Color by touch

The article "The Woman Who Tells Color by Touch" (April '64) started me thinking.

Possibly she is sensitive to minute changes in skin surface temperatures, and when normal body heat is transmitted to an object by conduction, that heat is absorbed or reflected to some degree as the object is dark or light. The dark objects absorb more heat, thereby taking longer for the skin to restore its lost heat. The light objects absorb less heat, so the skin heat is more quickly restored.

Does the woman have any medical history of fevers, or is she otherwise more than usually sensitive to wide ranges of temperature? Are her pulse rate and blood pressure normal? Does her pulse rate or blood pressure change perceptibly while exposed to different predominant colors? In an atmosphere of one predominant color, does she still produce dependable results on simple touch color perception? Does she have thin skin?

My reaction would be that through such a sensitivity to skin temperature changes, she has, over the years, come to relate such changes to the stimuli of various colors and she therefore has a learned response to colors. This theory is tenuous in the extreme, but may bear further looking into.

ROBERT K. PIERCE, JR.
Washington, D.C.

Obviously, if Mrs. Ferrell Stanley can "tell colors" by touch, she is accomplishing an impossible feat! So could she be "telling colors" by somehow "telling" the chemical structure of the colored substance by touch, which seems very much above the human capability, or by knowing somehow the amount of heat or energy that is given off when certain wave lengths of light are absorbed? Either way, she must unthinkingly be translating this knowledge automatically to the brain, registering the correct color.

BILLY ETHRIDGE
Jackson, Miss.

I do not believe "The Woman Who Tells Color by Touch" possesses any 6th sense.

I believe that Mrs. Stanley's fingers perform like an active infra-red detection system. Her fingers are sensitive enough to their own reflected heat from the different colors so as to distinguish them by their different heat absorption abilities.

The temperature limits mentioned in the article bear out this theory. It would be impossible to have such minute sensitivity over a wide range of temperatures. The future developments in infra-red technology will probably also bear out this theory.

JAMES H. YORK
Cheverly, Md.

Colored objects not only absorb different wave-lengths of light but also absorb slightly different degrees of heat and this gives colored objects slightly different temperatures. These experiments were done in the dark, but this still does not reduce the temperature of colored objects to the level where differences cannot be discriminated by the subject by rubbing them with her finger tips to identify them. The friction produced by rubbing increases the heat which is differentially absorbed by the colors so that they would have to be rubbed a different number of times to acquire a particular increase in temperature. When thin glass is put over the colors, this effect still occurs, but the heat transference by friction through thicker glass fails.

At very low temperatures, the subject would have to rub the color specimens so many times to get the colors to have different temperatures that she'd lose track of things. At high temperatures, since she can't lower the temperature by rubbing them, she'd make them approach even more equal warmness.

The subject failed a recent series of tests and one of the reasons given was stage fright. My theory agrees with this—stage fright made her hands colder and this tended to make all the colors feel warmer.

ROY DREISTADT
New York, N.Y.

"Acme Electric Razor Company!"

HOW RELIGION
WHAT DOCTORS

by Arthur J. Snider

A NEW dialogue is developing between the men in white and the men in black.

Doctors have found that people are never closer to God than when they become afflicted. Over and over the cry is heard, "Why has God done this to me?" As they lie on the sickbed, their arrogance and their feeling of independence lost, they resolve to correct their moral vices and resurrect their religious faith, if only God will heal them.

They are acknowledging that their recovery may depend on a power beyond the skills of the most competent physician.

Dr. Milford O. Rouse of Dallas, vice-president of the American Medical Association's house of delegates, says every physician has seen unmistakable evidence of Divine Will when of two patients with similar symptoms, physical conditions and therapy, one survives and one dies.

Dr. William J. Mayo of the famed Mayo Brothers has said that while the sick man needs faith in his physician, "there comes a time when faith in a Higher Power may be necessary to maintain his morale and sustain him."

For example:

There is an automobile accident, and a small child is thrown from the car and killed instantly. The mother, the driver of the car, has a mild shock, a simple fracture of the leg, bruises and lacerations.

HELPS TO HEAL

& CLERGY REPORT

The next morning her personal physician calls on her in the hospital room and says: "Martha, you are going to be fine. In a few days you will be able to go home. With a walking cast, you will be able to take care of your family. There are no internal injuries."

Martha replies: "That is true in your mind, perhaps. But I need to die. I have lost my child, which is God's punishment to me."

The physician summons her clergyman. Martha's problem is not one for medicine alone. A working partnership with God Himself is needed to bring about Martha's spiritual as well as physical healing.

The author of the best-seller *Three Faces of Eve* once told of a patient who had suffered a serious coronary thrombosis.

"I was with the patient constantly for 72 hours," said Dr. Corbett H. Thigpen of Augusta, Ga. "Each breath was taken with great effort as though it would be his last. His physician held little hope for his recovery. Finally, the patient looked at me and said, 'Why don't you go home. I am not going to die. I have three sons that I have to educate.'

"Suddenly I knew this patient was not going to die. He had faith. My response to him was, 'I believe you. I will see you in the morning.' This man not only recovered from his heart attack, but against the advice of all of us resumed his role in life as a farmer though he could only

The charlatan or faith healer harms the ill who have religious convictions. "They open to question the matter of faith," says AMA.

walk 50 feet at a time without having to stop and rest. Three months after his heart attack, he had plowed 14 acres of land with a mule. This man lived eight more years. He educated his children and died suddenly of a massive coronary thrombosis."

A theologian, Wayne E. Oates, professor of pastoral care, Southern Baptist Theological Seminary, noted: "In the most serious illnesses, the simple will to live becomes a significant determinant of the prognosis of the patient."

How does faith serve to bring about an organic change in tissue? This is not known, replies Dr. Raymond White of the American Medical Association staff, but the "comforting effect of faith is obviously related to a change in the emotional reaction. This in turn causes a change in body chemicals that affect tissue. With the psychological factors of the stress reaction being altered, the patient is better able to conserve his physical resources."

Whatever the explanation of the healing power of faith or of the sometimes dramatic 'cure' of the medicine man or of the evangelist or of the holy waters of Lourdes, doctors have little doubt that the emotions or "psyche" have great influence over the body or "soma."

Today, most physicians agree that as many as 50 percent of the patients seen in their offices have complaints for which no organic cause can be found. The problem is usually traced to troubled emotional patterns. Patients are usually unaware of the emotional disturbance causing the trouble.

It is not fair to say that the psychosomatic symptoms — headaches, upset stomach, fatigue, muscular pains, rashes or itches—are imaginary. They are real. But it requires something other than medicine or an operation to remove them. The hypertensive patient, for example, often improves when he feels free to express his pent-up hostile feelings.

The greater the success in switching the patient's attention from symptoms to his personal affairs, the sooner the basic emotional problems will come to light, physicians have found. Doctors encourage the patients to talk about themselves, their worries, their fears.

Among conditions that have been linked at least in part to both the psyche and the soma are: backache, muscle cramps, tension, bronchial spasms, sighing respirations, breathlessness, fast-beating heart, peptic ulcer, ulcerative colitis, diarrhea, blurred vision, insomnia, irritability, fatigue, loss of appetite and obesity due to compulsive eating.

The new dialogue between doctors and clergy has the official sanction

of the AMA, which recently set up a Department of Medicine and Religion. Its director is the Rev. Dr. Paul B. McCleave.

Dr. McCleave is quick to point out where medicine draws the line in the role of faith in healing. He warns especially against the charlatan "faith healers."

"The faith healer who lays on hands and says you no longer have cancer is doing a great disservice to those of religious faith," comments Dr. McCleave. "People who go through this process and return home are still ill. I would like to know what happens to them. No doubt their cancer or their alcoholism becomes worse. But more than that, they open to question the matter of faith. They thought they had a relationship with the Creator and now they feel the Creator has dropped them off on the side. The grief that must go into the hearts of these people is profound."

Both faith and therapy

Dr. McCleave says, "We do not say 'faith healing.' I do not believe American medicine has ever made a statement with respect to it or the matter of 'miraculous cures.' We say 'faith and healing.'

"The healing professions recognize that faith plays an important part in total health but theologians also recognize that there is disease and it is controllable by therapy."

How does the department look upon Christian Science?

"It is my understanding," Dr. McCleave says, "that the Christian Science group does not recognize the need for medical skill, drugs and services. Because of this, we as a department are not in relationship with this group for we recognize that in man's care it takes both medicine and faith for total well-being."

Christian Science also disparages the faith cure. It professes not to rest on blind faith in the unknown but on an "enlightened understanding of God."

A patient who is receiving Christian Science help but needs practical care may avail himself of a Christian Science nurse. The Mother Church maintains two sanatoriums where nurses are trained. When bones have been broken, a patient may employ a surgeon to set them, if he desires, providing no medication is involved.

The history of the relationship of medicine and religion goes back many centuries. In primitive civilizations, man believed illness was a visitation of evil spirits and the priests sought to drive out the spirits with magic. As man became more civilized and as priests learned more about the human body, the priests became physicians. They presided over the Aesculapean temples which served as hospitals in Greece and the Hellenistic world. Significantly, they were concerned with treating the "whole man," a concept which again is returning to the therapeutic arts.

But with the dawn of scientific medicine, at the time of Hippocrates

"A neurosis," Sigmund Freud called religion; "brainwashing," was what clergy called psychoanalysis, and the battle was joined.

of Cos, medicine and religion began to drift apart. The physician became increasingly concerned with man's body and his present life while the minister concerned himself with man's soul and future life. The two professions seemed to delight in accentuating the distinctiveness of their particular areas.

"It is hard for us who live in this century to appreciate that our forefathers were so obstinate and quoted so many Bible verses to hinder the progress of medicine," comments Granger E. Westberg, associate professor of religion and health, University of Chicago.

The serious modern split

The most serious modern split between the ministry and medicine came in the field of psychoanalysis. Some of it can be attributed to Sigmund Freud, founder of psychoanalysis, who shocked a Victorian culture by asserting that religion was a neurosis. He contended that God was the figment of an imagination, created by man as a figure to replace his own father on earth and projected into heaven. This dependency, Freud maintained, prevented one's growth to full maturity and the independence necessary for a healthy emotional growth toward adulthood.

The clergy, on the other hand, bitterly attacked Freud for practicing what they called "brainwashing." They looked upon Freud's theories as a serious threat to organized religion's teachings. They said analysts weakened moral and spiritual standards and permitted free expression to the point of licentiousness.

George Christian Anderson, director of the Academy of Religion and Mental Health, says the society cannot afford the luxury of quarrels between psychiatry and clergymen.

"We must cross-examine both psychiatry and religion to discover what each has to offer, which is relevant and above all, which is true," he says. "Unhappily there are many falsehoods in psychiatry and falsehoods in religion. When this is compounded with ignorance and prejudice, the magnificent treasures in both fields of knowledge are lost to those who could benefit."

Too often, Anderson says, religion confronts truth with fiction, while psychiatry often confronts facts with illusions.

"Psychiatry, as a specialty of medical science, cannot ignore any data, religious or otherwise, which have a bearing on theapy or an understanding of disease," he continues. "Likewise, religion in its

search for truth cannot blind itself to certain indisputable facts in the field of psychiatric medicine and behavioral science which have been confirmed by empirical evidence and observations.

"Clergymen who are excessively preoccupied with guilt-provoking practices and teachings can be a threat to the mental health of an individual who is predisposed toward neurosis or psychosis. The heightening of guilt can be harmful to one whose mental apparatus is already holding a full load of anxiety. The development of a certain amount of guilt has a valid place in religion, but the ministry of clergymen is to make people healthy, not ill. Religious leaders betray their own faith when they intensify fear without the offer of forgiveness."

Re-examining an old claim

A Freudian claim that needs to be re-examined is the flat accusation that religious practices are universal neuroses, Anderson says.

"While there are many religious practices that feed the neurotic need of those who engage in them, many others nourish psychological health. Fellowship, trust, forgiveness, respect, sincerity, integrity, humility, responsibility and constructive goals for living motivate many religious practices.

"Today, many psychiatrists recognize that religion has resources of vital significance which can help restore the psychic and physical health of those who are ill," Anderson stresses. "On the other hand, there is a growing number of clergymen who appreciate the fresh insight and knowledge which is emerging from psychiatry, medicine and the behavorial sciences.

What about the charge that psychiatrists are atheists?

"Freud's teachings about God and religion are being disputed by some of our foremost analysts and medical educators," Anderson asserts. "I know many psychiatrists who are deeply religious and active in their churches and synagogues. Others, while not fitting too precisely into organizational moulds, have a genuine regard for the sacred and a recognition of higher and ultimate powers."

In a recent issue of the *Journal of the American Medical Association,* Dr. Franklin G. Ebaugh, professor-emeritus of psychiatry at the University of Colorado Medical School said "I have met very few psychiatrists who are atheists."

"I would venture to say further," he added, "that if a psychiatrist were atheistic in his own convictions, this would have little influence on his prescription of treatment for his patient.

"A physician is able to only aid the natural health-seeking process present in every human being. A man is unhappy when some factor within his life milieu prevents him from striving with full energy toward his self-ideal, within his own scheme of values.

"If the patient is failing to live up to his religious values, if the life

Forty-four states have formed local committees since the AMA announced formation of its new Department of Medicine and Religion.

situation prevents him from doing so, or if deep equations within himself are in conflict with his religious convictions, then religion becomes a part of the therapeutic picture. The outcome for such a man's faith, however, will be determined by his own inner forces and not by any theological predilections of his psychiatrist."

Dr. Edward Rynearson of the Mayo Clinic believes physicians with a strong religious faith are better able to help patients who are in trouble.

More rational, less emotional?

He concedes such a generalization will be "promptly rejected by the atheists, the agnostics and by many very intelligent people who cannot accept such an oversimplification and who believe that intelligent physicians can help intelligent patients by more rational and less emotional methods.

"Perhaps so," he insists. "But I sincerely believe that I am a better physician by virtue of my strong religious convictions."

Rabbi Dr. Immanuel Jakobovitz of the Fifth Avenue Synagogue of New York believes a deeply religious conscience is the only effective guarantee that a doctor will maintain the qualities of responsibility and humanity in even the most trivial procedures.

"The absence of a spirit of reverence and humility and complete dedication is no doubt responsible for more suffering and deaths than mere lack of technical skill or medical knowledge," Rabbi Jakobovitz said.

Today, the coldness of scientific medicine and the realization that more than half of the patients seeing doctors today have psychosomatic symptoms—have brought about a new partnership between doctors and the clergy.

The extent to which this partnership is desired at the grass roots level is seen in the phenomenal growth of medicine-religion committees among the medical societies of the 50 states. Since the announcement on June 17, 1963, of the establishment of a Department of Medicine and Religion by the American Medical Association, 44 states have announced formation of state committees.

"Our group's purpose is to arrange frequent small group meetings between physicians and members of the clergy," explained Dr. Joseph R. Mallory, chairman of the Illinois State Society's Committee on Medicine and Religion.

"We are also publishing a handbook on clinical theology to offer

practical guidelines of conduct for both doctors and clergy in the best way to serve the spiritual needs of the patient."

The Academy of Religion and Mental Health was organized 10 years ago to serve as a catalytic agent in stimulating programs among medical, psychological and religious groups of the country. It has 4,000 members, including 10 percent of all the psychiatrists in the United States. There are branches in 70 cities.

For years, the medical school and the theological school at the University of Chicago stood on the same campus within 300 feet of each other. But until the last decade, they could have just as well been 300 miles apart. Then the faculties of each school began to talk about their need to work together. Granger Westberg, a theologian, has an appointment in the medical school as assistant professor of religion and health.

Theology students, who are for the most part ordained ministers working toward advanced degrees, spend time in the medical center making rounds with doctors and seeing patients.

"We are committed to the view that neither the doctor nor the minister can do his best work in isolation from the other," Westberg sums up. "If man is an indivisible entity and if the doctor and the minister have dedicated their lives to serving him, then we had better get together."

When East meets West they speak Pidgin

Don't knock Pidgin English! It's a second language spoken by 30 to 50 million people, as many as speak Javanese, Korean, Polish, and Ukranian. It can be regarded as a language in its own right, and not a form of international baby talk, says the National Geographic Society.

Peace Corps volunteers going to the West Coast of Africa are taught to speak it, for it is the only common language for peoples living along 2,000 to 3,000 miles of the coastline.

In Australia's dependency of Papua, in southeastern New Guinea, the natives speak about 750 different languages. Pidgin is the closest thing they have to a mother tongue. Recently, Pidgin-speaking Australians went all over Papua telling the tribesmen about a forthcoming "bigfella elekson" for the territorial House of Assembly.

In Pidgin, a word is reiterated to show intensity, and meanings are precise. When someone says, "Big fella talk talk talk watch 'im that one," he doesn't mean orator, he's talking about a high-pressure salesman.

Pidgin started in the ports of the South China Sea in the 17th century. The early traders couldn't speak Chinese, but they worked out a jargon of English with Chinese syntax. "Business English," the Chinese called it, but somehow it came out "Pidgin."

First aqualung in the U.S.

The great sport of SCUBA diving got its start in America through the efforts of scientist-adventurer Conrad Limbaugh.

by Jim McMillan

BY THE time of Conrad Limbaugh's death through tragic mischance, in the spring of 1960, the term "diving scientist" had become so familiar as to lend little distinction to the obituaries. Ironically, this was largely due to Limbaugh himself. It was he who first took a newly imported French "gadget" and, through urging and example, made it into an established tool of research at this country's, and the world's, largest oceanographic research institution.

Connie's story starts in landlocked Chicago, on June 28, 1924. When he was six months old, his father, the poet, Denton Limbaugh, and his mother, Doris, moved to Texas, still further from the sea. In Texas, the future biologist acquired a deep interest in living things that was to last throughout his life. Turtles, snakes, snails, and spiders were brought home, where they were as carefully cared for as any other child's cat or dog. When a family move took him to California it seemed only natural to pack the menagerie in a trunk and bring it along. His new home at Bellflower, Calif., also brought a wealth of tidepool life within reach.

Enthusiasm drove Connie to the water before he was able to stay afloat, and by the time he was in his teens, "Burrhead" and "Hammerhead," two of the all-time surfing greats, began to take him along. It was their custom to stop at the rocky patch of coast called Little Corona and dive for abalone, using masks made from old coffee cans. Diving, at that time, was the pre-

Ron Church

Limbaugh photographs a small fish cleaning the parasites off other fish off Guadalupe Island in 1959. His theory of "cleaning stations" added to our knowledge of symbiosis.

serve of a handful of hardy enthusiasts.

When he was fourteen, his first contact with trained scientists came through membership in the museum's conchological club. Connie surprised everyone with shells collected alive. Although he was one of the youngest members, he was able to get shells which other people couldn't.

Jim Drever, a friend, improvised a diving helmet out of an old water heater about this time, and Connie built a boat. The two of them would row out and dive off Corona del Mar, using a tire pump and welding hoses.

World War II interrupted these happy pastimes. The same military logic which sets marksmen peeling potatoes sent the born frogmen to a weather station in the Yukon.

One good thing came out of the stint at the weather station. The GI Bill afforded Connie an opportunity to continue his studies at Long Beach State and at Whittier, even though it was a rough go, eating, diving, studying, and playing football on the money alloted by his checks. Sometimes these would get several months behind, and he would be reduced to a diet of oranges, avacados, and peanut butter sandwiches. When things got really

Dr. Kenneth Norris

In 1949, Limbaugh posed on Newport Beach while using the first aqualung ever to reach the United States.

bad, he would go down to Little Corona, get a load of abalone, and sell a number of Whittier students on the idea of a paid abalone fry.

Despite his natural aptitude for biology, Connie nearly graduated without anyone mentioning the possibility of graduate study and a scientific career. At the last minute he applied at U.C.L.A., and was enrolled as a graduate student in ichthyology, in the spring of 1949.

A Frenchman named Rene Bussoz arrived in Westwood about the same time, and set up a little shop which sold swim fins, diving masks, and spear guns. One day Rene called the student ichthyologist into his back room and said, "Look what we have here." His surprise was a single bottle model of Captain Jacques Yves Cousteau's revolutionary aqualung—the first to arrive in the United States. Connie was the first American to use it.

The combination of SCUBA and enthusiastic, athletic biologist was irresistible. At his urging, U.C.L.A. purchased a lung.

After three semesters at U.C.L.A. Connie went to Scripps Institution of Oceanography and began his studies under Dr. Carl Hubbs, professor of marine biology. He immediately began to proselytize the use of the aqualung.

Scripps had already employed a helmet diver during World War II. Several of the oceanographers had even gone down in the cumbersome rig, but limited mobility curbed its usefulness. Most information about even the shallowest part of the sea came from collecting and measuring devices lowered on cables.

Now it was possible to plunge down 200 feet and actually observe and collect!

A fight was going on in California when Connie arrived at Scripps. Sports fishermen, seeing harvesting craft chew their way through the kelp beds, believed that the practice was detrimental to sport fishing. The harvesters retorted that it was not. In fact, nobody knew too much about the relationship between the kelp bed and the fish which lived in it. Connie decided upon an ecological study of the kelp beds which was to last five and a half years. His survey gave the first comprehensive picture of the complex cycle of life in California's offshore jungle. Controlled harvesting, it turned out,

actually helped the beds, by thinning the upper layers and letting sunlight reach the young plants. Also, the fish in question were found to be bottom species, not directly associated with the kelp, so that they were little disturbed by the actual harvesting operation.

Complete elimination of the kelp was another matter. At White's point, near Los Angeles, a great deal of money had been spent to pipe the sewage outfall a mile from shore, into 160 feet of water. The divers found, however, that the buoyant effulant ascended in a plume to the surface and soon drifted inshore. Limbaugh predicted the near elimination of the Palos Verdes kelp beds, which has now come to pass.

An accident prompted one of Conrad Limbaugh's greatest contributions to the practice of free diving in this country.

One morning in 1953, Robert Dill, Andreas Rechnitzer, and Connie made a jump into Scripps Canyon. A minor error in position put them into water 316 feet deep, and they found themselves groping about the oozy bottom in complete darkness. Afterwards, they were stricken with skin bends.

The implications of the accident resulted in the safety program which is the basis for training, not only at Scripps, but in the U.S. Navy and all over the United States. Connie's carefully thought-out course included rigorous instruction in the physics and physiology of diving, as well as in the actual use of SCUBA. One of his first pupils was Nan

Nan Limbaugh

Limbaugh's wife Nan, took this picture of him in diving gear at Scripps Institution of Oceanography, about 1958.

Bollender, who became his wife a year later, after securing a certification to 100 feet.

Walt Disney financed several of Connie's projects, in order to get nature films. One of these involved a study of the rare California sea otter, as they frolicked in the kelp beds off Big Sur. Near Guaymas, on the Gulf of California, Connie and Earl Murray spent 4 to 5 hours a day underwater, feeding fish until they were tame enough to observe and film. At the end of their stay, Connie herded all the Manta Rays out of a bottle-necked lagoon, while another diver stood on the bottom and filmed their passage.

In 1956, in the Bahamas, he did more filming for Disney, working with the Pedersen brothers. There he observed enough of the process

of cleaning symbiosis to formulate his theory of "cleaning stations." Already, Connie's underwater observations had led him to conclude that the conventional "tooth and nail" concept of wildlife was one-sided. A great deal of cooperation took place in nature. In the process of cleaning symbiosis certain fish allowed other fish or certain species of shrimp to clean them of the parasites which attacked flesh and gills. In an area systematically cleared of "cleaners" a large part of the fish population soon became ulcerated and diseased.

Connie's researchers, alone and in cooperation with Scripps scientists such as Hubbs, North, Rechnitzer, Dill, Stewart, and Sheppard, were endless. Studies were made of the manner in which Scripps Canyon "flushed" itself each year with an undersea avalanche.

Marine ecology was perhaps his forte. In addition to Herculean collecting efforts, he studied the life histories of many fishes in great detail. In gratitude to the great diver-oceanographer who had invented the tool of these researchers, Connie decided to name one of the species he had discovered in honor of Captain Cousteau. Connie's diving time could now only be estimated in months, rather than hours, spent underwater.

In the spring of 1960, Limbaugh interrupted his work on the distribution and ecology of sea animals, the physiology of diving, and underwater photography to represent the United States at the International Underwater Confederation meeting in Barcelona. There he was presented to the delegates by Cousteau, himself. Afterwards, Cousteau's associates drove him to the French Riviera for a tour of diving and visiting marine research stations.

On March 20, when he was preparing to return to La Jolla, an invitation came to explore a limestone cave which discharged its stream of fresh water directly into the sea. His guide, Michel Poudevigne, had taken many people into the cave, near Port Miou. The object of interest was a narrow "chimney," which rose from the flooded interior to the surface of the ground. Due to some terrible confusion of language or gesture, Connie misunderstood the French diver, and tried to follow when Poudevigne dropped to the bottom beneath the chimney to retrieve his flashlight. They became separated, and Connie, lost, swam in under the hillside, away from the sea.

Days later, a search party found him far inside, his mouthpiece still in place.

Of course Connie's diving career at Scripps was not a one man show. Many of the Institution's salty scientists took to the aqualung under his tuition, and his program is being continued under a new diving officer, James Stewart. But, as a colleague said, "Connie noticed things down there that other people didn't even see." And it was Connie's enthusiasm which did so much to introduce the aqualung as a standard tool of oceanographic research in this country.

INSIDE PSYCHIATRY TODAY

Was Freud wrong about dreams?

by Flora Rheta Schreiber and Melvin Herman

DID YOU dream last night? Whether your answer is yes or no, you did. Everyone, according to the newest theories about dreams, dreams every night, whether or not he knows that he did. Everyone, moreover, dreams all the time that he is asleep. You must, in fact, dream to live.

You dream from 20 to 25 percent of your sleeping time. Even newborn infants, who sleep all the time, dream. So do lower animals.

Startling? Yes. Startling, too, is the quiet quest, yielding new insights into the nature of dreams, that is taking place in research laboratories throughout the land. Dramatically this new research challenges—and in fact overturns—the time-honored, traditional theories about dreams based on the findings of Sigmund Freud.

"The traditional concept about dreams," says Dr. William Dement of Stanford University, "as occasional, unpredictable and fleeting is no longer tenable. The discovery by Drs. Nathaniel Kleitman and Eugene Aserinsky that rapid eye movements appear at certain times during sleep and that these can easily be recorded electrically in the sleep-

ing person, has led to important dream studies."

While the persons volunteering for these experiments slept, laboratory workers charted their eye movements, their brain wave patterns, their breathing and their galvanic skin responses.

The workers also awakened the sleepers at appropriate times indicated by the instruments and asked them to recall their dreams, whose substance was then carefully recorded.

Special attention was paid to rapid eye movements. On the basis of these eye movements two separate states of sleep in which dreams take place, were established. In deep sleep, there are rapid eye movements (REMS). The state, in the new vocabulary of dreams, is known as REM sleep. Lighter sleep is not characterized by these eye movements, but by a smooth, regular respiration and a stable, slow heart rate.

The two states of sleep, the researchers showed, yield two different types of dreams. In the overwhelming number of instances, sleeping persons awakened while they were showing rapid eye movements had been dreaming a traditional dream of a hallucinatory type. Persons awakened during the lighter phases of sleep also could recall what they had been dreaming. Their dreams, however, consisted of unrelated visual images and abstract thoughts.

So markedly different are the two types of dreams that the experimenters can tell, even before checking with their instruments, the stage of sleep in which the dream occurred.

The rapid eye movements are supposed to correspond to the activity in the dream. The dream vision takes the place of outside stimulation that affects us when we are awake. This dream vision, moreover, causes the same responses that are induced when we see something while we are awake. For our mental processes do not distinguish between what we see in a dream and what we see when we are going about our daily business. The only difference in reaction to the two kinds of stimulation is that during sleep our motor activities are inhibited and we cannot express our reactions.

The dreaming of infants

The experiments also studied the dreaming patterns of newborn infants and lower animals. The similarities with adults are more striking than are the differences. The rapid eye movement patterns of newborn infants are like those of adults. Though these patterns vary in the lower animals, some are close to man's. In the opussum, which is considered "a living fossil," the patterns approach man's more closely than do, for instance, similar patterns in the cat.

Before these experiments, dreams a la Freud were regarded as "the guardian of sleep," without which there would be wakefulness, a sort of perpetual insomnia. It was also

believed that outside stimulation, impinging upon the sleeper, brought him to light sleep and that it was in light sleep that he began to dream. The dream, moreover, kept him from awakening, perhaps by incorporating the stimulus into the dream and thus pushing him back into deeper sleep. By staying asleep, the person could turn off the screaming siren of the fire engine or his own need to get up for a drink of water. It was only when the protective mechanism failed, that the sleeper awakened.

Today, however, largely as a result of the eye movement experiments, the "guardian of sleep" theory has been repudiated. Deep sleep (REM sleep) as a rule cannot be induced through stimulation. Moreover, persons awakened in the two different stages of sleep showed no effect whatsoever in their overall sleep patterns. Once the person had gone back to sleep, the periods of wakefulness were promptly forgotten. Since, too, there is no evidence that interrupted sleep is in any way harmful, the experimenters concluded that there is no bodily need to preserve sleep through the assumed "sleep guardian" mechanism of the dream.

Freud believed that during sleep we have two poles of consciousness, a sort of North Pole and South Pole. At the extremes of these poles, he envisioned two markedly different states—one, the extreme alertness of being awake and of responding to stimuli reaching the cerebral cortex; the other, the state of being asleep and of being completely shut off from stimuli to the brain.

The new theories not only abolish these poles of consciousness, but also maintain that sleep, instead of being a state in which there is no stimulation to the brain, is in fact a time of very considerable mental activity. The exciting assertion is that the brain activity that occurs during dreaming in deep sleep is often greater than that which takes place while we are awake.

"If we regard as dreaming any mental activity occurring during sleep," says Dr. Dement, "then dreaming takes place all through sleep." Adds Dr. Walter Bonime, "The dream differs from the waking mental product only in that it is not a communicative effort with the

This is the first of a series of monthly features offering intensive coverage of the latest advances in psychiatry. The series is prepared by Flora Rheta Schreiber, an award-winning writer on psychiatric subjects, and Melvin Herman, executive secretary of the National Assn. of Private Psychiatric Hospitals.

Persons deprived of dreams for 15 days showed personality changes. In an experiment depriving cats of their dreams for 20 days, the cats died.

concomitant process of selecting a particular message."

Freud thought dreams are fleeting; that therefore a dreamer's account of some long involved dream was only a subjective elaboration of mere flashes. Today's view, however, is that dreams pervading the two different kinds of sleep, each of which is an independent state with its own characteristics and its own manner of dreaming, account for approximately an hour and one half per night of more or less formal dreaming. Dreaming, however, in the form of mental activity, as we have said, occurs all through sleep.

Formerly, too, dreams were believed to gratify repressed wishes, or to represent symbolic meanings so that when you dreamed of a monster, it was really your husband or your father; when you dreamed of a witch, it was actually your wife or your mother.

Today's conception, however, is that, instead of representing repressed wishes or symbolic meanings, dreams are "day remnants"—the material from the previous day reverberating through the dream. If the dream has a meaning, it is now believed to be one that is not evoked by wish fulfillment or gratification of the instincts, as Freud thought. When, for instance, the subjects in one of the experiments were kept thirsty for the sake of the research, their dreams did not reveal the quenching of thirst. Neither thirst nor its symbolic equivalent entered their dreams.

In the Freudian view, too, dreams were considered accidental occurrences, whereas today they are regarded as organic—as much a function of the human body as are eating and breathing. They are viewed as so fundamental that they are said to fulfill a biological need; that in fact we must dream to live.

So-called dream deprivation studies suggest that the dream affects our daytime personalities, or rather being denied a dream does. For when sleeping persons were deliberately awakened at the beginning of a dream, they carried the effects of the interruption into the next day by being irritable and unable to concentrate. Moreover, when the experiment was repeated for 15 days, these dream-deprived persons showed marked changes in their personalities. A similar dream deprivation experiment with cats yielded even more drastic results. After 20 days of being denied their dreams, the cats died.

The practical implications of these new theories promises to be very great. Take just the altered concept concerning the mental activity that takes place during sleep.

The difference between having your mind on virtual vacation while you are asleep and of having it work for you all through the night makes it appear that there is more sense than nonsense in the old dodge, "I'll sleep on it." Since the mind is working even though we may be unaware of it, the problem unsolved during the day's conscious plugging may well resolve itself during the more relaxed mental activity of sleep.

Dreams needn't shame us

The fact, too, that dreams reflect our normal waking life rather than our deep-seated urges should make us less afraid of remembering our dreams and the more ready to let their content infuse our waking life. Perhaps, as we learn to accept our dreams, we shall be able to use them as an aid to our daily activities. Creative persons in particular can look to dreams as a spur to ideas if only they will train themselves to remember. But even if they don't remember, the thought that seemed muddy when they went to bed has a new illumination in the morning because of the night's dreaming.

Today, we are in the midst of a new awakening about dreams (forgive the pun). Everywhere within the psychiatric world, because of the new experimentation leading to new theories, we stand on the threshold of still newer concepts about dreams. So far—as the experimenters themselves caution—the conclusions have been based on sleep and dreaming in controlled situations and may not be a precise gauge of the natural state of dreaming. Quite possibly, for instance, the man who is irritable the day after he was awakened and deliberately denied his dream, is irritable not because of the lost dream, but because of the abnormal circumstances of having been awakened as part of an experiment. Nor, by any means, is there universal acceptance that the Freudian view is wrong; the new view, right. Quite possibly, further investigation will restore at least some elements of the old view. In one area, however, there is widespread agreement: The events of the preceding day are largely the stuff of which dreams are made.

New investigations will also probe the important connection, newly glimpsed, between the biological and the psychological aspects of dreams. Since, too, dream analysis is part of normal psychiatric procedure, new insights into the nature of dreams will inevitably lead to new psychoanalytic approaches.

What is the value of a dream, we may ask?

It doesn't tell your future, give you a chance to even up your score with the world, or even gratify your repressed desires.

But it is a source of energy, of mental power, a part of your very existence, an ally of your waking life.

So much for dreams. For what's new on sleep, turn the page.

DO YOU NEED 8 HOURS SLEEP?

Some people say they need at least eight hours of sleep every night. Others seem to get along just fine on five or six. Science is beginning to explore the complex effects of sleep on our body—and it is discovering some surprising things.

by Andrew Hamilton

We sleep away about one-third of our lives—an average of between seven and eight hours every 24-hour day.

But do we really need this much sleep? Is it a habit rather than a necessity? Could we train ourselves to get along on less? Would fewer hours of sleep impair our physical and mental well-being?

A score of researchers in the United States and Europe are asking such questions. The answers they come up with may be important to all of us in this busy world.

Pioneer work in the scientific investigation of sleep was done over a 40-year period by Dr. Nathaniel Kleitman of the University of Chicago, now retired and living in Santa Monica, Calif.

Until recently, it was thought there was only a wakefulness center in the brain, and that when it relaxed, sleep took place. But new evidence suggests there may also be sleep centers in many parts of the brain that work in direct opposition

to the wakefulness center. There may also be changes in the blood during sleep or wakefulness.

According to Dr. Joe Kamiya of the University of California School of Medicine, San Francisco, a former associate of Dr. Kleitman, people can cut down on their sleep. An individual who normally sleeps eight hours may be able to get by on five or six—at least under experimental conditions. Curiously enough, once the experiment is concluded the individual often goes right back to his usual sleep quota.

Experiments have been made by breaking sleep into two cycles a day —for example, from 4 a.m. to 8 a.m., and then for a brief hour or two in the afternoon. Following such a regimen, some subjects found they were as alert and no less tired than if they slept eight hours at a stretch.

Four hours a day

One of Dr. Kamiya's college friends slept from 4 a.m. to 6 a.m., and again from 4 p.m. to 6 p.m. for a period of a year. Such a schedule was sufficient for him. "This was a short-range experiment," warns Dr. Kamiya. "Before any such plan could be generally recommended, we would have to know more about what the effects would be on health and behavior, and whether they were applicable to all individuals."

Short-range sleep schedules have been proposed on the grounds that we sleep more deeply during the first few hours of sleep. But as Dr. Kamiya points out, depth of sleep may not be the same thing as restfulness of sleep.

Studies of this question have yielded conflicting results—perhaps because not enough persons were observed. In the population at large there may be many people like Thomas A. Edison who need only four hours of sleep a night and a few "cat naps" during the day. Others, however, might never healthfully adapt themselves to such a schedule.

There are now machines that induce sleep—or at least a sleep-like state of consciousness—in both animals and human beings. The technique consists essentially of brain stimulation by tiny electrical impulses repeated again and again. A dog, for example, can be put to sleep in a matter of seconds with such a procedure. But as soon as the electrical stimulation is cut off, the dog is wide-awake again.

"Whether or not this is true sleep is open to question," says Dr. Kamiya. "It is my belief that many more studies will be needed before we can be sure that this technique actually induces natural sleep, or that our sleep requirements can be compressed in such a manner. But I would not rule out the possibility that electrical stimuli or drugs might induce the need for sleep."

One phase of Dr. Kamiya's own research is aimed at determining how much a person actually hears and responds to sounds while asleep. To explore this question,

he and his co-workers have devised an ingenious experiment. A tiny switch is taped to the finger of a volunteer subject called "Jim." When Jim is asleep in his laboratory bed, a tape recording is set in motion carrying the command, "Hey, Jim, press the switch!" This instruction is repeated every eight seconds or so, in ever increasing intensities, until the subject does press the switch.

"We've already had a number of surprising results," says Dr. Kamiya. "Individuals can be 'asleep' by all common meanings of the term, yet show an auditory sensitivity that is close to wakefulness.

"Furthermore, a simple test such as this reveals a number of important variables that help to determine what sleep really is. For example, after three or four nights of simply repeating the command to press the switch, we reach a cut-off point with some of our subjects. They ignore the command altogether. It appears, then, that some people can exclude disturbances to their sleep—just as a New Yorker never hears midnight traffic noises or the banging of garbage cans.

"One other interesting variant. Tell the subject that he will receive $1 for pressing the switch, and that he will receive $2 for responding at lower intensities. What happens? His ability to respond to the command is greatly increased. Even though he's snoring, you sometimes wonder if he is actually asleep."

University of California investigators have also explored a related question: if a sleeping subject can hear at low intensities, can he also learn? Evidence to date is negative. People can't remember even simple tape-r e c o r d e d words or phrases—even though the material played may wake them up.

"Many commercial firms advertise 'Learn While Asleep—French, German, Money-Making, Improving Your Personality' and so on," says Dr. Kamiya. "Yet all the work we and others have done tends to show that if a person is truly asleep, he does not learn a thing. At least not at such a complex verbal level."

Old sayings discredited

Sleep researchers have also rechecked many old bromides about sleep. For example, it is now known that no person "sleeps like a log." Through observation of thousands of persons, it has been well-established that the average individual changes the position of his body many times during the night. In Dr. Kamiya's laboratory, 20 to 40 movements per individual is typical.

Nor is it true that an hour's sleep before midnight is worth two afterwards. Sleep is sleep no matter when you get it. Of course, if a person is used to going to bed before midnight but doesn't make it until 1 a.m., he may think that pre-midnight sleep is the best. But this is only because he lost his usual amount of sleep—not because an hour's rest is more beneficial at one time than another.

Another striking fact, revealed

through brain wave studies and the observation of sleeping subjects, is that a person's own testimony about how long he has slept is notoriously unreliable. People who have had more or less a normal night of sleep —as revealed by an electroencephalogram—sometimes claim to have slept only a couple of hours.

Unreliable also is a person's estimate of how long it took him to fall asleep. He may report 15 minutes when in fact it was 45. More typical, however, is his belief that it required 45 minutes when in reality it was only 15.

Among current problems concerning sleep—or the lack of it—is insomnia. It has been called the typical American ailment. And with good reason. An international survey conducted several years ago indicated that 52 percent of the Americans interviewed said that they had trouble going to sleep.

Worrying about insomnia probably only aggravates the problem, according to many researchers. Thinking and muscular tension stimulates the wakefulness center in the brain.

Telling yourself, "I've got to get to sleep, I've got to get to sleep" creates muscle tension and is usually self-defeating.

How then to get to sleep?

An oft-recommended practice is to begin with one part of the body—say the feet—and imagine that the muscles are sagging. They are completely loose and relaxed. Then work up the body, imagining that the trunk, hands, arms and even the face muscles are totally relaxed. Open the mouth slightly so that the jaws are not clenched.

In the opinion of sleep researchers, considerable nonsense has been expounded about the benefits of what are termed "scientifically" designed mattresses and inner springs. It is pointed out that a large proportion of the human race sleeps on the ground—sometimes on mats, sometimes on the bare soil. Wooden pillows are popular in Japan and other countries. So, if a particular surface seems restful, sleep on it.

Some people find that a nightcap helps them to doze off. Others swear by a glass of warm milk or an hour of relaxed reading. Small doses of barbiturates and other sleep-inducing drugs can be taken—assuming that your doctor approves. But continued doses may lead to addiction.

"We still are lacking many answers to basic questions about sleep," points out Dr. Kamiya. "We're not even sure that we can answer the question, 'Do you need eight hours of sleep a night?' Many more experiments and longer-range investigations need to be conducted by physiologists, psychologists, psychiatrists and biochemists."

"Maybe what we need," he said, half-jokingly, "is to find ways to cut down the need for wakefulness. In our culture it's the desirable thing to be as active as possible. But we don't really know whether this is intrinsically good or healthy. More research will tell us whether to choose between more sleep or more wakefulness."

Inventor of the month

An inventor since his childhood interest in perpetual motion, Harold Kosoff is a successful independent.

He made it in his garage

IN THE family garage, Harold Kosoff, a 33-year-old Philadelphian, has invented and built a simplified free-piston engine that has attracted the attention of industry.

The *Science Digest* Inventor of the Month believes his engine offers great economy as an air compressor. "A 20-horsepower free-piston engine weighing 30 pounds and costing an estimated $40 to build," he said recently, "is equivalent in output to the conventional 20-horsepower air compressor that weighs about 400 pounds and costs about $1,000."

Further, he asserts, his compressor engine uses about half as much fuel and has only 130 parts, less than the total in the carburetor and fuel pump of the usual machine. He claims superiority in the compressor intake valves, internal air cooling, and lubrication.

Prospective jobs for such compressors include driving pneumatic drills, spraying paint and blowing up automobile tires.

What *is* a free-piston engine? Essentially it is a tube with a combustion chamber in the middle and a pair of loose pistons. The pistons move outward toward the tube ends at each explosion. The cushions of compressed air at the tube ends bounce the pistons back to the center where, in diesel fashion, they ignite fuel.

If it has no crankshaft, how do you get useful work from a free-piston engine? For his air compressor, Harold Kosoff pumps air into a tank. If it were used to drive a car, a hydraulic pump could be geared to the wheels.

Kosoff plans to harness his engine for the generation of electricity, feeding it with domestic gas. For this purpose, magnetic circuits can be built into the pistons and windings can be attached to the cylinder. As the pistons move back and forth, electric current is produced. The inventor predicts that the cost of current will be from a third to a fifth of utility company rates.

Here again, Kosoff believes, the mechanical simplicity will result in large savings. He estimates that a 10-kilowatt free-piston generator weighing about 50 pounds and costing about $60 will equal the output of a conventionally driven generator weighing 700 pounds and costing about $1,000.

Among recent Kosoff patents are No. 3,127,881, covering his piston synchronization, and No. 3,129,878, on the over-all cylinder and piston design. Working models, using acetylene as fuel, have been exhibited to manufacturers. The National Inventors Council, to whom the engine was

submitted, recently referred it to the Air Force for evaluation.

Harold Kosoff is a computer programmer. He was first attracted to invention by a boyhood interest in perpetual motion schemes. This led him to practical studies of internal combustion engines. After getting a B.A. in physics from Temple University, he studied mechanical engineering at Drexel Institute in Philadelphia.

—*Stacy V. Jones*

INVENTIONS PATENTS PROCESSES

The crib you sit in

THE old days of baby's trundle bed, stored in the attic, seem to be gone forever. Now the new parent can purchase a crib that folds up into a chair to save livingroom space, and for the globe-trotting infant who accompanies his parents on trips, a handy travel kit is available.

Donn-Scott Products, Inc., 2 Park Place, Bronxville, N.Y., is marketing a lounge chair that can be converted into a baby's crib, playpen, or a youthbed in 22 seconds.

Designed to solve the problem of storing and hauling a crib, the product, Chair-Ub, can later be converted into a youthbed which accommodates a child up to five years old, after he outgrows the crib.

A boon to apartment dwellers is this baby's crib which doubles as livingroom chair.

Vacationing babies' personal needs can be met with this compact traveler.

Chair-Ub has a rich walnut or antique white finish, three cushions covered with Naugahyde or Naugaweave stain-resistant, heavy-duty vinyl fabric. It comes in ten colors. The company also offers a cocktail table that becomes a crib.

Today's baby is apt to get around more than yesterday's did, but he must still have his diapers, powder, bottles, and other paraphernalia. To help fill these needs, Johnson & Johnson offers a Baby Needs Traveler, including baby oil, lotion, powder, and cream, as well as cotton buds.

A suitcase with a leather shoulder strap, it is divided inside into two sections, one a washable diaper tray and the other designed to hold baby toiletries and to hold and insulate nursing bottles. As the child grows up, the compartments can be removed to make his own 10-by-15-inch suitcase.

Another item in the company's updated line of baby gift sets is the Baby Travel Kit, also filled with Johnson & Johnson products. It is a vinyl foldover case which contains the baby's toiletry needs in fitted transparent pockets. The kit can be carried in a suitcase, or can be hung by its strap in a car, train, or in a motel room. For information on either product write: Baby Gift Set Division, Johnson & Johnson, George and Hamilton Streets, New Brunswick, N.J.

Now for sea and sand

Three new products for those who enjoy water sports are: a frilly and glamorous sun and swim cap which adds a new look to women's beachwear, an inflatable family runabout, and an aid to learning water skiing.

Now even a sun bonnet can take to the sea with Playtex's distinctive bathing cap.

Playtex's double-duty swim cap is a ruffled beach bonnet which protects both hair and hairdo from the sun, safeguarding delicate hair shades. When it's time for a dip, the wearer slips a rubber undercap onto her hair and snaps the bonnet over it. Once on dry land again, a good shaking dries the ruffled nylon bonnet and it is ready to go back on the head.

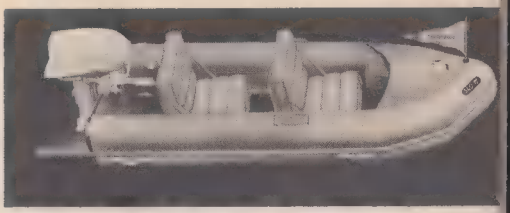
Comes in pink, magenta, royal, light blue, lime, black, and white. For further information write International Latex Corp., Empire State Bldg., 350 Fifth Ave., New York, N.Y.

A family knockabout, which holds four to six people and is suitable for shallow waters, turbulent rivers, and ocean surf, is available from the Kayak Corp. of America, Inc., 133 West 45th St., New York, N.Y.

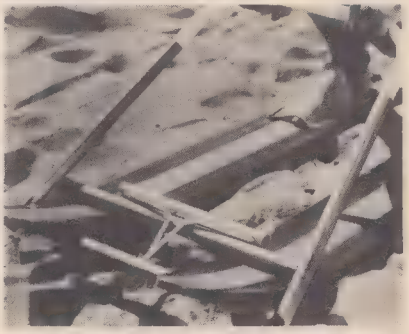
The Nautisport Inflatable Runabout, Model 340, is 9 feet 10 inches long and 4 feet 10 inches wide when inflated. Eighteen-inch tailfins are said to have enough bouyancy to support a large outboard motor. The boat comes in two strong canvas carrying bags. A high-volume foot pump, maintenance kit, carrying handles, utility bag and pennant are included.

Inflatable benches and a pair of sectional oars may be ordered separately.

The boat has a full sectional wall-to-wall marine plywood floorboard with a heavy wooden keel attached. It can be assembled in less than 20 minutes and requires no maintenance, according to the company.



An inflatable family craft, Nautisport Model 340 seats up to six.



A trainer for those interested in learning to water ski is one of new surf products.

Its main material is nylon coated with Neoprene, which is sun, oil and saltwater resistant. The 340 has four independent airchambers for safety. The transom will take outboard motors up to 25 hp, providing more than enough power for waterskiing at speeds over 30 mph.

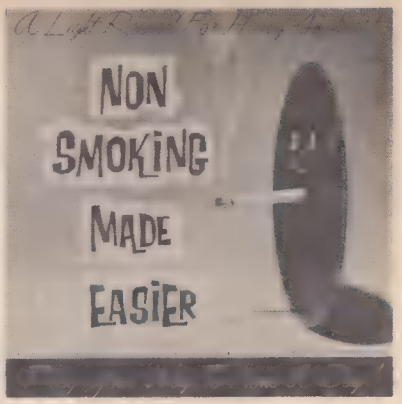
For those who want to learn to water ski without the many hazardous spills learning the sport usually entails, the Skee-Trainer is offered by Nassau Shores H. & G, Dept. 93, 5500 Merrick Road, Massapequa, N.Y. The Skee Trainer is a lightweight metal frame which you slip over your ski tips to hold them together. The boat pulls on the skis, you hold on to the

handle. When you reach skiing speed, you press on the handle to release the ski tips and use the Trainer as a regular ski handle.

Heartbeats you can't hear

The Cardio-Sensor, an electronic instrument which is said to pick up where the stethoscope leaves off, is manufactured by Mastercraft Medical & Industrial Corp., Jamaica, N.Y. It can detect heart activity after the stethoscope has lost the beat and the pulse has disappeared, thus helping determine whether a patient is still alive.

Dead or alive? The Cardio-Sensor is a tiny electronic instrument, more sensitive than a stethoscope, designed to detect even the faintest heart beat.



For those who want to stop smoking, an LP record may lend more conviction.

Kicking the habit

Among the latest and most unique aids for kicking the smoking habit is a record, "Non-smoking Made Easier," designed to be played whenever the reformed smoker feels the urge to pick up a cigarette. Available from Fuller Barclay Records, Suite 205, 11950 San Vincente Blvd., Los Angeles, Calif., 90049.

How to forward a phone call

A Call Diverter which electronically switches incoming calls from one telephone to another, regardless of location, is offered by the Marcom Corp., Oakland, Calif. It is available only through telephone companies, which lease them to subscribers on a monthly basis.

By turning a series of thumb wheels, the user sets the number of the second telephone that he wishes to be called on, and switches the Diverter on. The Diverter senses incoming calls and automatically dials the pre-set number—local or long distance.

The biggest building job of all time

There is no doubt that a new Panama Canal must be dug. Technically this enormous project may be relatively simple. Politically it looks difficult.

by John W. Finney

THE United States cautiously is building up to the most spectacular construction feat of all time: using nuclear explosives to dig a new trans-isthmian canal.

The idea is appealingly simple. Detonate a few hundred thermonuclear explosives underground, and a sea-level canal will be blasted out, connecting the Atlantic and Pacific Oceans. What's even more appealing is the estimate that the canal could be dug in one-fifth the time needed by conventional methods, and at one-quarter the expense.

There has been a belated realization, however, that the limited test ban treaty of 1963 may greatly restrict the development of nuclear explosives for such peaceful purposes. When the test ban treaty was signed, the Atomic Energy Commission was not even consulted on whether the proposed treaty terms would inhibit the development of nuclear explosives. Now the Commission is besieged by Executive Branch and Congressional requests for reports on how nuclear explosives can be used to dig a ditch that would supplant the 50-year-old Panama Canal.

The U.S. program had its origin in another canal crisis—the one in Suez in 1956. Dr. Harold Brown, then a chief scientist at the Livermore Radiation Laboratory in California and now Director of Defense Research and Engineering, began studying the possibility of using nuclear explosives to carve another canal through Israel. Out of those studies grew Project Plowshare which, from its birth in 1957, has lived under a cloud of suspicion and skepticism.

In 1958 emotions were running high over a test ban, and there was widespread suspicion even in this country that Plowshare was a cover for weapons testing.

If there also was widespread skepticism about the worth of nuclear explosives, it was largely because in those early days the scien-

Comparison of proposed sites for a new sea-level canal.

Site	Length (Miles)	Maximum Elevation of Divide (Feet)	1947 Estimated Costs for Conventional Excavation (Millions)	1960 Estimated Costs for Nuclear Excavation (Millions)
Mexico (Tehuantepec)	125	810	$13,000	$2,300
Nicaragua (Gerytown-Salinas Bay)	140	760	$ 4,100	$1,900
Panama (San Blas)	37	1,000	$ 6,200	$ 620
Panama (Sasardi-Morti)	46	1,100	$ 5,132	$ 770
Colombia (Atrato-Truando)	102	950	$ 5,261	$1,200

tific advocates were imaginatively extravagant in their claims.

Then came the test moratorium from 1958 to 1961. Just at a time when the scientists needed to do some experiments to substantiate their claims, they were prevented from conducting tests. Project Plowshare tended to recede into the obscurity of the back pages of the AEC's annual report.

Two events—one technical, the other diplomatic—came to the rescue of Plowshare. The technical development was the first major nuclear excavation experiment, called Project Sedan. On July 6, 1962, a 100-kiloton thermonuclear device (a kiloton equals 1,000 tons of TNT) was exploded 635 feet in the desert alluvium of the Nevada test site. The explosion created a crater 1,280 feet wide and 320 feet deep—dimensions that incidentally correspond closely to those planned for a sea-level canal. The crater was somewhat deeper than expected, so with the first experiment it was possible to reduce substantially the estimated explosive needs for a canal project, thereby reducing the expected costs and anticipated radioactive fallout.

The diplomatic development was the squabble between Panama and the United States over the present canal. It had been evident for some time that, for both commercial and strategic reasons, a new canal would have to be built eventually. (See "Last Days of the Panama Canal," July '63.) The present canal is becoming obsolescent. Even today there are 24 U.S. naval vessels and 50 commercial ships that are too large to pass through the canal locks; and an additional 556 commercial vessels cannot go through fully laden. By 1980 or 1990 the ship traffic will exceed the capacity of the present canal.

The basic idea of nuclear excavation is very simple. Explode a nuclear device at the right depth, and a large hole is created, with material thrown up on the edge of the crater. Explode a row of explosives, and a ditch is made. For a trans-isthmian canal, for example, about 300 nuclear explosives would

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John W. Finney is the science correspondent in Washington, D.C., of the *New York Times*

be used, carving out a series of ditches that would then be connected.

The obvious problem is radiation. The fallout hazard, however, is essentially eliminated by the nature of the device and the way it is exploded. The explosive is a thermonuclear device that gets only a small fraction of its energy from the fission process, which is primarily responsible for producing the radioactive debris of fallout. In an underground explosion, about 90 percent of this debris becomes permanently trapped in the molten rock created beneath the floor of the crater. Most of the debris that escapes falls close to the crater, and only a small amount is blown downwind from the explosion.

'Dirty' device used

In the Sedan shot, for example, workers were able to return to the lip of the crater within a few weeks, and to descend safely into the crater after eight months—and this experiment was conducted with a relatively "dirty" device, with about 30 percent of its energy from the fission process. In the past two years, considerable progress has been made in developing "clean" nuclear explosives with only a few percent of fission energy.

At most, it is believed, the radioactive fallout would constitute a temporary health hazard up to a few tens of miles: an area that would obviously be evacuated during construction of a canal.

According to an army study, the cheapest sea-level canal dug by conventional methods would be produced by conversion of the existing canal, at an estimated cost (in 1947) of $2.287 billion. For nuclear excavation, five possible routes were studied: the Tehuantepec route across southern Mexico; the Greytown-Salinas Bay route across Nicaragua and Costa Rica; the San Blas route, about 40 miles east of the canal zone; the Sasardi-Morti route, 110 miles east of the canal zone; and the Atrato-Truando route in Northern Colombia.

(Recently a 10-man team from the United States went to Colombia to study the possibility of building a new sea-level canal. Colombian government experts assisted in the survey.—ED.*)*

Of the five routes, the San Blas one is generally ruled out for nuclear excavation, because of its closeness to the populated areas around the Canal Zone.

Because of inflation, the 1947 estimates for conventional construction undoubtedly are now too low.

By exploding a nuclear device at the right depth, a hole is created, with material thrown up at the edge. A row of explosions will create a ditch, the basis for a canal.

AEC commissioners were embarrassed almost to the point of being tongue-tied and had to admit the treaty was restricting their cratering experiments.

Advances made in the past few years on explosive devices and excavation technology make it now appear that the 1960 cost estimates of nuclear excavation are too high.

Unnoticed report

The Army report submitted in 1960 went virtually unnoticed, until a scientist happened to write a letter to a Senator, and some Panamanian students marched into the Canal Zone. Last November, Dr. Gerald W. Johnson, director of Project Plowshare at the Lawrence Radiation Laboratory, wrote a letter to Senator John O. Pastore, chairman of the Joint Congressional Committee on Atomic Energy, reporting that nuclear excavation of a canal seemed "even more promising" than in 1960. In the not so mysterious ways of Washington, the letter found its way into public print in mid-January, just when the Johnson Administration was arguing with Panama over the present canal. The White House reaction was to call the various departments to make a quick study of the feasibility of building a new sea-level canal with nuclear explosives. Out of this study came a high-level statement of policy presented to the Senate Commerce Committee on March 3. The joint statement by the State and Defense Departments contained this key paragraph:

"A combination of economic, political and strategic considerations makes it highly desirable to proceed with necessary studies (for building a sea-level canal). Our evaluations to date indicate that the United States should proceed expeditiously in the belief that eventual construction of a sea-level canal is desirable and in our national interest."

Nowhere in the statement was nuclear excavation specifically mentioned, but it was apparent that the Administration was quietly starting down that path, for no other method of construction appears economically feasible.

Along with reawakening of interest in Project Plowshare has come a belated recognition within the Administration that a rather vague, ill-defined provision in the nuclear test ban treaty could restrict the development of nuclear excavation technology. This specifies that no nation shall conduct a nuclear test which "causes radioactive debris to be present outside the territorial limits of the state under whose jurisdiction of control such explosion is conducted."

During the treaty ratification hearings, Administration officials left the impression that the treaty would not inhibit development of the peaceful applications of nuclear explosives. Within weeks after the treaty was ratified and specific experiments had to be passed upon, the Administration was obviously having second thoughts about what peaceful experiments would be permissible under the treaty. The problem was not development of explosive devices, which could be tested in completely contained underground explosions. The question was whether the United States could conduct the six to ten cratering experiments needing to be carried out before the excavation technology can reach the point where a canal project can be undertaken.

The cratering experiments, by their very nature, release some radioactivity, and some of the bigger proposed experiments almost certainly would cause minute but measurable amounts of radioactivity to be carried beyond the U.S. boundaries. The normally meticulous diplomats, however, had not defined how much radioactivity would constitute "radioactive debris." Was it enough to "contaminate," as Secretary of State Rusk indicated in his testimony? Or was it "measurable" radioactivity, as others said? And, if so, what constitutes a measurable amount, since this depends largely on how much technical effort is made to detect it?

It is little wonder, therefore, that the AEC commissioners were embarrassed almost to the point of being tongue-tied when they were called up before the Congressional Atomic Energy Committee in late February, and had to acknowledge that the treaty was restricting the cratering experiments.

Just how far the United States can proceed under the treaty will depend in large measure upon the attitude of other nations. Fortunately the Administration has some time to spare for international promotion. Contrary to the impression created by some of the early propaganda, nuclear excavation of a canal is not just around the corner. It will take five years at a minimum to develop the excavation technology, and a similar, somewhat concurrent period to develop and produce the few hundred nuclear explosives. Thus, it will be five to ten years before the United States is ready to take on the canal project.

Central America and Russia

Meanwhile the United States may persuade some Central American country to throw open a corridor for nuclear excavation, and may win the concurrence of the Soviet Union. At least there are some grounds for optimism for the latter. During the treaty negotiations, Premier Khrushchev privately indicated to American officials that Soviet engineers were interested in developing peaceful uses of nuclear explosives, and that it might be possible to come to an agreement later.

With this device an investigator can hear what's being said behind a closed door.

Are you being bugged?

Big Brother may not be watching you, but if somebody is, you'll probably never know it.

by Bruce H. Frisch

LESS than three weeks after publication of Vance Packard's *Naked Society,* a snooping tool he called a possibility was the hit of the spring convention of the National Association of Broadcasters in Chicago.

It is an electronic device for making TV audience surveys. Carrying a rotating loop antenna stuck up front like a giant hood ornament, a truck cruising at 15 miles per hour picks up a weak signal from your TV set and sends it to a computer in the back. Without anyone's peeking in the window or asking your consent, a printer taps out in one minute the channels you and 105 neighbors are watching.

The rapid development of electronic eyes and ears is just one of the threats to privacy covered by Packard and by a former investigator, Myron Brenton, in a similar book, *The Privacy Invaders,* but it is the most frightening.

Manufacturers, for instance, have squeezed a closed-circuit TV camera into a four-inch-thick slab that can be slipped into the air-space between walls to shoot upward into a mirror, or fit behind the grill in a ventilation duct or inside fake humidifiers.

The device is used today to keep an eye on customers in banks, supermarkets and department stores, including try-on rooms. It stares distrustfully at employees all the way up to top executives.

Even darkness is no shield. Now there are TV cameras that can see by infrared ray.

But it's still probably easier today to duck out of sight than out of earshot. Under average conditions, the latest parabolic microphone can pull in a conversation from 100 to 150 feet, and in quiet surroundings from up to 500 feet. A dish three to six feet in diameter gathers in sound and concentrates it on a microphone in much the same way a solar furnace collects light. A St. Louis firm has been selling a small, transistorized Big Ear for $18 to amuse the kiddies.

The machine-gun microphone extends the listening range to several hundred feet. A bundle of tubes, some of them up to seven feet long, feeds sound into a microphone from a narrow field directly ahead.

Most familiar, perhaps, is the single-tube microphone seen on television. A seven-foot-long Electro-Voice model on a stand costs about $1,000.

In comparison, the old-fashioned wiretap is a bargain. To use it in its most elementary form, one need only clip an earphone to the telephone wires. For as little as $4.25 at most electronic supply houses, you can buy a coil that picks up a phone conversation without touching the wires. The magnetic field set up around the telephone wires by the electric current carrying the voices produces a weaker replica of the current in the pickup. Affluent investigators may pay up to $30 for professional quality.

A properly equipped tap can be left unattended. The induction coil is hooked to a tape recorder with a $76 to $105 device for running the recorder only when someone talks. Another device converts dialing clicks into a telephone number.

By tracing his wires, a suspicious telephone subscriber may find such a setup and seize the tapes. For $200, a tapper can get insurance in the form of a miniature radio station weighing less than a pound and a half which will relay the tap to a distant spot.

If a tapper can get direct access to the handset, he can hook up his transmitter in a three-wire tap, the most deluxe kind. He not only gets all telephone conversations, but by using the mouthpiece as a microphone, gets all conversations within range of the telephone.

Now that this epidemic of electronic eavesdropping has been recognized, will it be stopped? Maybe, but the breakthrough in diagnosis could be cancelled by new breakthroughs in virulence. Due in the fall: a two-year study by the Association of the Bar of the City of New York on the threat to privacy. Topics will be: brain waves, lasers, subliminal and subaudial messages, and secretly administered truth drugs.

For how bugs work, how much they cost, and how to find them, turn the page.

Bugging equipment has been so miniaturized that a car can be turned into a receiving station for a secret transmitter. All necessary equipment can be held in a briefcase.

How a bug works

by Bruce H. Frisch

A BUG is a small, secret radio transmitter, or more generally, any kind of eavesdropping plant. The size of bugging equipment has shrunk almost to the vanishing point since the invention of the transistor and dime-sized battery. As the bug shrank, the industry grew. Today, 30 companies supply the government, law enforcement agencies and anyone else who can pay. Over half the business is claimed by Mosler Research Products, Inc., Danbury, Conn. Their pictures and equipment illustrate these pages.

One attraction of a transmitter is that it puts a safe distance between an eavesdropper and his victim. In the comfort of his car an intrusion specialist can tune in to a hidden FM transmitter up to a half mile away. The receiver on the armrest is wired to the car antenna and feeds the amplifier-speaker resting on the seat. All the equipment is part of a $550 receiver kit packed

With probe and earphones a counter-intrusion specialist looks for telltale signs of a transmitter which may be hidden inside a picture on the wall, or almost anywhere else.

in the ordinary leather briefcase.

The size of transmitters extends down to a mock cube of sugar; the range, down to a few feet. To stretch an extremely short range, a relay receiver-transmitter may be hidden nearby. A larger off-the-shelf set is about as big as a matchbook and has a range of one to two city blocks.

Size depends partly on the battery. With the general utility size transmitter, a one-pound battery pack may last 200 hours, while a 10-ounce pack dies in four hours.

A man getting set for a long listen will tap power from a clock or TV set. Generally, however, intrusion specialists count on transmitters for quick jobs only. They are too easy to detect with a probe.

The counter-intrusion specialist—usually an instrument specialist who has temporarily switched to a $435 search kit fitting in an attache case—watches the needle on the probe handle and listens for a squeal in his earphones. Here he closes in on a

To find microphones that may be hidden inside the wall, the counter-intrusion man can conduct a search with a small mine detector. A hidden bug will register on the dial.

transmitter hidden in the painting on the wall. This $215 package is a favorite for hotel and motel rooms.

A microphone with wires leading directly to a tape recorder is safer from discovery. Good places for the quarter-size microphones are in the backs of desk drawers, in upholstery and on the undersides of beds. The fine wires blend almost out of sight when colored to match the background.

Once a suspicious pair of wires is found, a sound generator can be clipped to them, turning the microphone into a buzzer and revealing its hiding place.

To complete the search, the counter-intrusion man can sweep the room with a small mine detector. Placing a microphone behind a pinhole in the woodwork or plaster mutes the detector alarm to a murmur. Connecting the mike to the hole by a plastic tube puts the mike deep enough into the wall to escape detection entirely.

An alternative evasion tactic is to

A spike driven into the wall, with a contact microphone pressed to it, is so sensitive that it may pick up too many noises from surrounding rooms and mask conversation.

drive a spike into the wall or door and press a contact mike against the mating end. But unless the surroundings are exceptionally quiet, the door or wall picks up other nearby vibrations which may mask the conversation. Nevertheless, counter-intrusion men like to look at all the rooms around the one they are protecting.

In spite of careful precautions, a radio transmitter can come walking in the door concealed in someone's inside jacket pocket, its antenna running down his arm. A counter that has been successfully used against this plan is for one of the defending force to wear a radio probe on his arm as he listens to tell-tale squeals with an innocent looking hearing-aid earpiece.

But there is little defense other than a frisk for the tape recorder hidden in a briefcase or taped to the small of the back, with a tiny microphone strapped to the stomach, or built into a tie clasp or wristwatch.

KFS

Kaiser, right center above, and officers, meet with Britain's Lord Lonsdale, dark uniform, before the war. Hindenburg is at extreme left. Below: Gavrillo Prinzip is arrested at Sarajevo after assassination of Archduke Ferdinand which led to war.

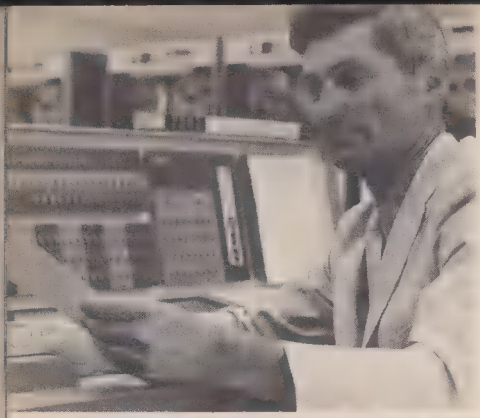
A COMPUTER

by W. Steve Bacon

As Lord Kelvin, famed 19th century British mathematician and physicist, once said, "When you can measure what you are speaking about, and express it in numbers, you know something about it. But when you cannot measure it or express it in numbers, your knowledge is of a meagre and unsatisfactory kind." Thanks to our rapidly expanding computer technology, more and more things can be expressed in numbers. The story of Stanford University's studies in "International Conflict"—why wars break out and why small wars grow into big wars—bears this out.

Picking World War I as a thoroughly documented period of crisis with published speeches, press interviews, official releases, secret coded documents, diplomatic memos and

TELLS WHO STARTED WORLD WAR I



Dr. Robert C. North gets reading from computer used to analyze prewar actions.

other sources of information readily available, Stanford political scientists turned to computer technology to help analyze great masses of data. Working over the material for the critical six weeks before the war, the computers, an IBM 7090 and a Burroughs 220, came up with a number of startling conclusions, some of which run contrary to the history books.

Modern computers can handle mathematical problems at a truly fantastic rate—advanced machines solve thousands of complex equations in minutes—work that would take a team of expert mathematicians years to accomplish. When you ask a computer to handle words, however, the situation gets complicated.

The first step is to provide the computer with a "dictionary," that is, impress a signal of some sort at different "addresses" in the computer's memory, each representing a word. For the Stanford research, the computer was given a vocabulary of 3,485 words, 3,000 of which were commonly used words in the English language, and the rest, terms of political significance relating to the outbreak of World War I.

Next, the words have to be given various mathematical values so the computer can use them in computations. In this study, the words were "tagged" and "scaled" by three or more judges (human) who assigned each dictionary entry one or more of six dimensions: positive affect, negative affect, strength, weakness, activity and passivity. In "scaling" the words, the judges rated each dimension as to its importance on a scale from one to three.

The result was that the machine could be fed a word such as "abolish" and quickly spit out an analysis: in machine language, "NEGISTR3ATV3." To interpret, the word "abolish" has a negative affect of low intensity, and a connotation of strength of high intensity, and a connotation of activity of high intensity!

Next, the computer was "taught" the names of people and places in a separate geographical and biographical dictionary. The word "Kaiser," for example, triggers a conditioning response in the machine that might go as follows: "KAISER = WILHELM + GERMANY + EMPEROR + PRUSSIA + KING." Finally, the machine was equipped with special "overstate" and "understate" tags so that it could analyze a statesman's manner of speaking. It was also instructed to disregard unimportant words and to allow for words of negation.

The most important step in elec-

tronically analyzing World War I was to break the data into "themes" or basic units consisting of the following: (1) the state which perceives the action; (2) the state whose action is being perceived; (3) the action itself; and (4) the target of the action.

Since there is no way by which a computer can discriminate between the functions of words in a sentence, it was also necessary to add subscripts to words conforming to the basic elements of the theme. Using the numbers above, an example might look like this: "Germany/1 feels/1 that France/2 is hostile toward/3 it/4." Still other subscripts were used to identify the time of the perception, whether or not the perceiver is perceiving something at home or in a foreign country, and whether or not he is offering an observation, an interpretation, or a reaction to something.

What were the startling conclusions that the machines came up with in their attempts to second-guess the historians? They reported that during those six critical weeks before The Great War, Germany and Austria-Hungary regarded themselves as targets of hostility rather than agents of it; that France felt the same way; that the decision-makers for all the five major powers involved—Austria-Hungary, Germany, France, Russia, and Great Britain—regarded themselves as "agents of friendship," and each felt its friendship was not returned.

The statesmen of each of the five major powers felt their "injury"

KFS

Britain's George V and Belgium's Albert visit front after continent-wide war erupted.

most strongly "at the time when they were making policy decisions of the most crucial nature." Thus, the Stanford researchers, headed by Dr. Robert C. North and including professors Jan F. Triska and Richard A. Brody, say that "at the very time when the situation most urgently required a calm assessment of events, intentions, and capabilities, leaders in Vienna, Berlin, St. Petersburg, London, and Paris were under the most severe stress."

While the conclusions arrived at by the computer can be easily disputed by professional historians, the scientists feel they have made an important point: world crises can be analyzed, and, given sufficient data, conclusions can be drawn that will assist policy makers.

As Stanford's Dr. North puts it, "The techniques of research we are developing may someday enable us to enlarge the saying that 'those who fail to learn from history are doomed to repeat it,' to include the further statement that 'those who fail to learn from computer projections of the future are doomed to experience all of its pitfalls.' "

Dive in a Thresher sub

by Hubert Pryor

I RECENTLY dove deep beneath the surface of the sea in a Thresher-class submarine. With other writers and editors invited along on the trip, I was apprehensive. Most of us had never before dived deeper than the bottom of a swimming pool. But I wasn't scared.

I was impressed, even excited.

Many times in my life, I have crossed the oceans, in passenger liners and assorted naval craft. I have flown across them. And I have gazed out at the sea from countless beaches.

But now I know the sea is not what it seems.

It is an element, like the air. It is not an endless expanse of water, sometimes smooth as a mirror, sometimes surging like a thousand stampeding herds. No. The sea is a vast medium, up to five miles deep and thousands of miles in expanse, in which you can move with the freedom of a plane in the sky.

You don't just head a Thresher sub in a given direction and go straight forward. You point the nose down and dive till your heart's in your mouth, throw the ship into a tight, banking turn, and then put

her into such a steep climb your feet feel embedded in the deck.

And never once do you come anywhere near the surface. Around you, unseen by ordinary vision but felt in your bones and observed on dials and sonar scopes, the fluid depths encompass you—never ominously or oppressively, but like an atmosphere that sustains you as it lets you through it, up, down, sideways, any way you want to go.

How to stop an enemy

The import of all this is not just poetic. When fully realized, as it is realized by Navy submariners, it opens up an utterly new frontier in weaponry, in the ways an enemy could attack us and we could stop him.

Polaris submarines, lurking in the depths of the world's oceans, ready to fire missiles thousands of miles to enemy targets, have become a familiar concept to most of us. But, if we can do that, so could an enemy. Then what could we do about it?

That was what our press group got to find out on our recent dive.

Our ship was a replica of the *Thresher* in nearly every respect, like all the other craft of the class to which the ill-fated sub gave her name. The name of our sub was the *U.S.S. Dace,* officially designated by the Navy the SSN607 (SS for submarine and N for nu-

The U.S.S. Dace, a Thresher-class attack submarine, cleaves the surface waters of Gulf of Mexico before going into deep dive.

Skipper of the Dace, Commander John A. Walsh, goes below. When hatches are closed and ship is ready for diving, her smooth black skin offers minimal drag. Ship's advertised speed submerged is over 20 knots.

clear). She was the sixth of her class, the second built in the yards of Ingalls Shipbuilding, a division of Litton Industries, in the pretty Gulf Coast town of Pascagoula, Miss.

The *Dace* had been commissioned April 4, six days before the first anniversary of the *Thresher* sinking off Cape Cod. We were going out in her 11 days after that tragic anniversary.

Safer than the Thresher?

We all wanted to know what had been done to make the *Dace* safer than the *Thresher*. We didn't find out much—principally, I suspect, because not much is really known about what befell the *Thresher*, and the Navy is not about to advertise what it has done to improve the safety of such advanced craft for the benefit of unfriendly submarine builders.

But our skipper, Commander John A. Walsh, a quick-smiling, tautly-wound ball of muscle and brain, told us that from the sacrifice of the *Thresher*, much had been learned. The naval court of inquiry said it believed it "most likely that a piping system failure had occurred," and Walsh and his officers described certain improvements in piping used in the *Dace*. I decided to accept that the improvements were adequate.

For our dive, we steamed down the ship channel out of the Pascagoula yards and headed for several hours out into the Gulf of

Mexico to escape the shallow coastal waters.

When we got out far enough, the order came, "Prepare to submerge." Minutes later the ship's horn blared twice and over the ship's intercom sounded the cry, "Dive, dive!"

There was a slight sound as the ballast tanks flooded, but the only sensation I felt was that the ship, which had been rolling gently on the surface, now steadied on her keel. After a while, there was a slight popping of the ears.

I looked at the depth indicator. One hundred feet. We levelled off. Two hundred feet. Again we levellel off. Then came that empty-stomach feeling. The announcement wasn't soon enough: "We are going into a ten-degree dive." All of a sudden, the deck was downhill. It held that way for some seconds. Then, at last, the pull-out. Another hundred feet down.

We went down the next time at 15 degrees. Then up at 20 degrees.

The next thing I knew, dishes started to clatter across the tables of the mess where a section of the crew was eating chow. I looked at the compass repeater, which tells you your heading, the direction in which you're going. We turned 90 degrees left, then 90 degrees right, then a full 180 degrees. Each turn took just seconds.

We put on speed, turned some more. Then we climbed and dived some more.

It was, I was told, a pretty tame exhibition. But it was enough, after

Ship's controls resemble a plane's because attack submarine dives, climbs, turns like a plane. Helmsman and planesman keep Dace on course while submerged with help of radar, other sensors. Left: diving officer.

over an hour of fast, sharp maneuvering, to show us that the U.S. today, in the Thresher-class submarine, has a craft that is a "fighter plane" of the deep.

Packs a missile punch

And that's not just words. The *Dace* and her sisters of her class are fighter ships. Consider just the punch these attack submarines, as they are called, can now deliver at enemy subs with the fantastic new Subroc (see *Science Digest,* Feb. 1964). A missile fired from torpedo tubes, it blasts out of the water, seeks out its target from the sky and then plunges into the sea to destroy it. Consider, too, the sonar equipment filling the great bulge of the *Dace's* nose to seek out the enemy, her nuclear power to keep her going submerged for weeks at a time, and her truly impressive diving and speed limits ("in excess of" 400 feet and "in excess of" 20 knots submerged). The *Dace* is a type of craft that opens up new worlds even to old salts. Forty-five such ships have been authorized, a few more even than Polaris-type subs. We are already well on our way to protecting ourselves against the terrifying power and efficiency of nuclear underwater offensive missiles like Polaris that an enemy might line up against us.

But the whole story of the *Dace* and other Thresher-class subs is not just the fantastic gadgetry. Reporters usually are a slightly cynical crowd. They accepted at little more than face value what Commander Walsh said at the end of a little speech the night before the trip.

"You will see a lot tomorrow that will impress you," he said. "But one thing will impress you most—the men."

He was right.

They were clean-cut, level-headed, devoted to their jobs. Officers and enlisted men, even though they were only just starting to work together, functioned as efficiently as a drill team. And all were impressively knowledgeable.

Submariners today go to school constantly, studying such subjects as nuclear physics and reactor engineering, oceanography, modern mathematics, boolean algebra, set theory, mathematical logic, automatic data processing, mechanics, ballistic rockets, submarine dynamics, solid state electronics, radiological monitoring and atmosphere control.

'A real sense of purpose'

In March of this year, Vice Admiral Elton W. Grenfell, commander of the Atlantic Submarine Force, told the New York Academy of Sciences that submariners are "the cream of our crop." He added:

"These men like their jobs, appreciate the advanced technological training they are receiving and believe in what they are doing.

"I found them to have a real sense of purpose."

So did I.

Amphibious passenger helicopter lands on 120-foot-high roof of Heliport Building.

NEW COPTER AT THE FAIR

For the story of New York Airways' Sikorsky S-61N, please turn page ▶

Big windows give passengers spacious view of Fair's dramatic layout below. Photographers get opportunity to shoot from either side because of copter's flight pattern.

THE first amphibious passenger versions of the Sikorsky S-61 in the U.S. are giving visitors a bird's-eye view of the New World's Fair and a new experience.

The S-61N carries 24 to 28 passengers depending on the seating arrangement. Its maximum speed is 149 mph and it has a range of 276 miles, although Fair passengers get just a 10-mile double loop over the 600 acres of pavilions, avenues and shows.

Two General Electric gas turbine engines power the aircraft with 1,250 hp each. Even if one engine quits, the copter can continue flight to a normal landing area on the other engine.

With floats attached to the landing gear, the S-61N could safely come down on any of the many lakes and other bodies of water in and around the Fair grounds.

S-61N's have been delivered to British European Airways and Pakistan International Airlines for scheduled passenger service. Military versions of the S-61's are the U.S. Navy SH-3A anti-submarine warfare helicopter, and the U.S. Air Force CH-3C cargo and personnel transport.

Another version, the VH-3A, is used to transport the President and other high government officials.

Los Angeles Airways has flown the land version for some time. The amphibious version is being flown at the Fair by New York Airways. The New York helicopter line operates regular passenger service between New York City's three principal air-

The S-61N is 59 feet 3½ inches long and the main rotor turns in a circle 62 feet in diameter. Copter's weight fully loaded is about 19,000 pounds. It flies at 140 mph.

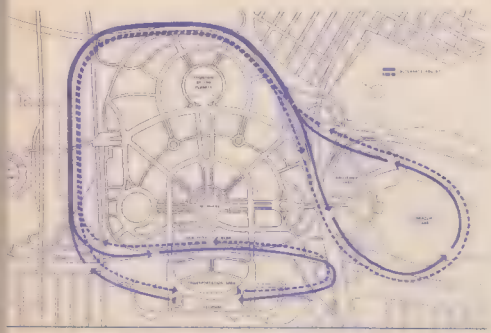
Same amphibious Sikorsky craft in service with British European Airways makes a water landing. The copter can climb at 1,300 feet per minute. Service ceiling is 11,500 feet.

ports and a heliport in the Wall Street area. An application to fly from the top of the Panam Building in midtown Manhattan was made this spring.

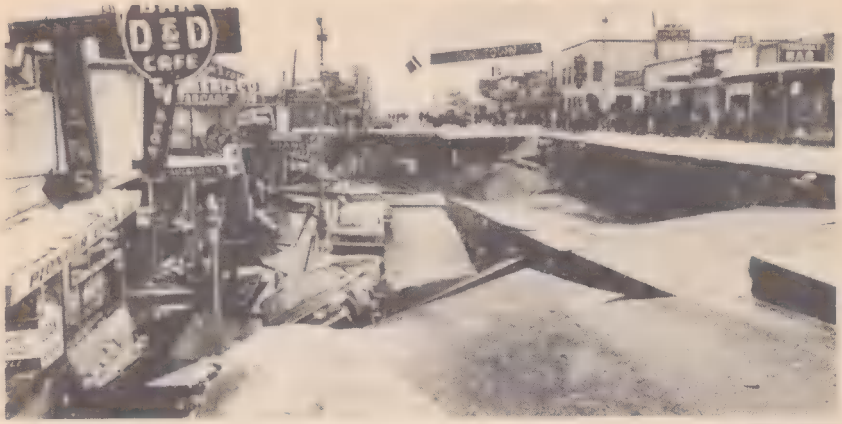
From the heliport building at the Fair, New York Airways is flying the S-61N's mainly for exhibition purposes (the adult fare is $6.50), but it also makes occasional connections to Kennedy International Airport. Recently, flights to Newark Airport also were planned.

Many visitors have never flown in a helicopter before. In the version at the Fair, they find a roomy craft comparable to a regular airliner, complete with stewardess.

One principal difference in the "feel" of the craft is that it takes off just a few feet straight up, then starts climbing up and forward with the nose down, not up. And if you've never before taken off from the roof of a building, as at the Fair heliport, you have one more sensation to look forward to.



Above: S-61N's flight pattern around Fair. Right: Young passenger shakes the pilot's hand. Above him are twin gas turbines.



Wide World

Buildings and part of a street in Anchorage, Alaska, dropped about ten feet out of position in the earthquake on Good Friday. The photo shows a damaged two-and-a-half block area on the north side of one of Anchorage's main avenues.

What's your quake I.Q.?

by John and Molly Daugherty

YOU'RE on a planet that was throbbing like a deep-toned bell following the earthquake in Alaska. You couldn't hear the bell toll because the sound was about twenty octaves below middle C.

How shaky is your knowledge of quakes?

1. After-shocks, sometimes severe, often follow major earthquakes like the one in Alaska. What is the probable explanation?
   a. Intrusive activity of magma, or molten rock, within the earth
   b. Elastic afterworking following the elastic rebound
   c. The theory of isostasy in the sinking and rising of earth to attain compensation

2. Most earthquakes are caused by:
   a. Volcanoes
   b. Lava flows
   c. Faulting (tectonic quakes)

3. Within which zone of depth do most earthquakes occur?
   a. In the outer crust to a depth of about 37 miles
   b. From about 37 to 156 miles down
   c. At depths from 156 to about 435 miles

4. When an earthquake occurs, several types of waves go out from the source or focus of the quake. Primary waves travel faster than secondary waves to the seismograph station. If you were a seismologist, what could you determine about the earthquake by noting the time lag between reception of these waves?
   a. Where the quake occurred
   b. How far away the quake is
   c. The depth of the quake

5. Which type of earthquake wave is most destructive?
   a. P—primary wave—longitudinal
   b. S—secondary wave—transverse
   c. L—long wave—a mixture of Love and Rayleigh waves

6. Which type of fault involves only tensional forces?
   a. Normal
   b. Thrust (reverse)
   c. Transcurrent (horizontal)

7. Volcanoes are:
   a. Burning mountains from which come fire and smoke
   b. Chimneys or vents connecting to pool of molten lava or magma at some depth
   c. Always explosive when they erupt and throw out ashes and gaseous mixtures

8. Molten magma which forms the lava flow from volcanoes and fissures in the earth may work its way close to the earth's surface but not break through. What happens to this magma?
   a. It remains molten for an indefinite period of time
   b. It intrudes between and across rock layers and solidifies
   c. It is dissolved by underground water

9. Which of these regions was formed by great lava flows?
   a. The Great Smoky Mountains
   b. The Great Plains of the Mid-West and Canada
   c. The Columbia Plateau of the Northwest

10. According to some seismologists, the Alaska earthquake had an intensity of 8.6, equal to that of the highest ever recorded in North America. In 50 years, from 1904 to 1954, about how many earthquakes occurred which closely approached 8, actually exceeded 8 in magnitude, or attracted unusual attention?
    a. 95
    b. 990
    c. 9

Answers:

1 - b The initial shock is a normal way to relieve the strain in the earth's crust. This is sudden but does not fully restore the rock structure to a condition without strain. A sort of creeping recovery from the rest of the strain takes place in a series of aftershocks.

2 - c Most earthquakes are tectonic. Tectonic refers to the forces present in mountain building. The fracture of the earth's crust under strain and the movement along the fracture is called faulting. An earthquake may occur along an existing fault line. The suddenness of the movement along the fault causes earthquake waves in the earth.

3 - a In the shallow zone. Many years ago we thought that earthquakes could not occur below a depth of about 20 miles. Now we know the foci of some earthquakes have been calculated to depths of 435 miles.

You find most of the deep-seated earthquakes along island areas of the Pacific, such as Japan.

4 - b How far away the quake is. You would consult a chart showing the distance according to the amount of time lag. Of course you have to have long experience and training to interpret the seismogram properly. For example, other primary waves which have been curved and reflected may follow the first primary wave.

To tell where the quake is, you would plot the distance from your station to the quake. Then you'd plot the distance from two or more other stations. Using these distances as radii of circles, you can determine the

location of the earthquake. It's where the circles intersect.

5 - c Long waves. The long waves are surface waves, rather than interior waves. They travel more slowly than P or S waves. P travels about 5 miles a second and S, about 2¾. L waves average about 2.

L waves are actually a mixture of waves named after Love and Rayleigh. Love waves are the transverse type which move horizontally. Rayleigh waves have a vertical component in their up-and-backward-rolling effect.

6 - a Normal fault. Tensions or strains may build up along a fault line for long periods of time. The fault line of fracture may be tilted somewhat from vertical. To relieve these tensions, sudden movement may occur which tends to pull the crustal blocks apart. The result is that one slides downward with respect to the other. If there is sudden relief of the strain, earthquake waves are generated. New fault lines may develop when fractures and movement of weaker rock structures occur due to tensions, compressions, or shearing.

7 - b The term volcano usually includes the vent and the cone or mountain which has been built up around it during the course of time.

Some volcanoes are quiescent. Lava may overflow the top or break out through the sides. The explosive type may blow the lava apart so that it rains down hot ashes. Other volcanoes in eruption are between these two extremes. There is little in the material erupted which is combustible. However, some pockets of hydrogen burn, but most of the appearance of fire comes from the red hot magma of the crater.

8 - b Intrusions of magma squeeze between rock layers, cut through rocks, and may arch up a level surface area. Geologists have names for these intrusions: sills, dikes, laccoliths, and batholiths. In the latter, the solidified magma may form the granite core of a mountain.

9 - c The Columbia Plateau region is covered by lava flows not from volcanoes but from fissures in the earth. You can identify separate flows varying in thickness from 20 to 200 feet where rivers have cut through the 1000 or more feet of lava flows. In some spots, you can identify 20 different lava flows.

The Columbia Plateau stretches several hundred miles from Wyoming to the Cascade Mountains in Washington and Oregon.

10 - a Sixty of the 95 had magnitudes of 8 to 8.6. The rest had magnitudes close to 8 or attracted special attention because they were very deep earthquakes. Deep earthquakes tend to register slightly lower magnitudes.

Score yourself:

9 - 10 right—Your knowledge is quake-proof.

4 - 8 right—You know your *terra* isn't too *firma!*

0 - 3 right—Your score's shaky.

The Hugh Downs Column

JUST A SECOND

UP TO a generation ago, the measurement of time had reached a level of refinement that gave a pretty concise idea of exactly how long a second was. The particular basis for this idea of the second has fallen apart.

Time is said to be the measure of events. We measure them with calendars and clocks. Calendars base the measure on regular natural events, and clocks, on regular artificial events (pendulum swing, spring-powered escapements, vibrations of crystals, etc.)

A personal sense of time is the conscious experience of duration.

St. Augustine puzzled over time as follows: "We cannot measure what does not exist. And the past and future do not exist. But how do we measure time present, since it has no extent? In other words it passes from that which does not

exist, by way of that which lacks extension, into that which is no more."

I'm at least as confused as St. Augustine was.

However, this doesn't keep me from frequently consulting calendars and clocks and imagining that I learn what time it is.

The basic division

The first attempts to measure the passing of time must have been based on the rhythm of day and night. The alternating light and darkness divided this period into halves, and the daylight half could be divided into dawn, morning, noon, afternoon, evening, twilight. Until a new kind of scientific time recently came on the scene, this was the basis for all systems of timekeeping. The day was divided into 24 pieces called hours, each of which was divided into 60 pieces designated minutes, each of which had 60 parts called seconds.

Wonderful.

What's the need of the new system?

Well, to begin with, the day is longer than it seemed to be. The problem is not as yet making itself felt in terms of catching your next plane or train or getting to work on time, because the discrepancy is extremely small, but it has accumulated to an appreciable fraction of a second since 1900.

I think you can see how that plays hob with the hour and also with the minute and second. The alternatives are: deal with a day that gradually becomes longer than 24 hours, or leave things alone with an hour defined as one twenty-fourth of a day and cope with clocks that appear to be speeding up!

The attempts to gain an absolute foothold in unchanging Time are shown in the many kinds of time scientists have adopted in the last few decades.

1. *Diurnal Time.* This is sometimes called Solar Time. A number of variations in the earth's motion make the actual astronomical day a most unreliable basis for accurate timekeeping. Since the earth is not rigid and hence not spherical (the centrifugal force of its own rotation gives it an equatorial bulge) and since its axis is not perpendicular to its plane of revolution about the sun (tilting over 23 degrees), there is a faint wobbling caused by gravitational effects of the sun and moon on the earth's girdle. There is tidal friction from motions of the atmosphere, the oceans and the crust. The earth is most like a quivering blob of jelly. This brings about changes in the earth's moment of inertia and makes the length of the day noticeably erratic.

These errors are themselves measurable and, over a period of time, can be averaged out so the second can be standardized. Or could be, except for one thing. The tidal forces referred to above are causing the earth to slow in its rotation, so a standardized second based on the length of the day is impossible.

2. *Sidereal Time.* The mean (or

There is a clock that has less than one second of error in 320 years. But we still don't have an absolute frame of time. So Hugh Downs relies on sun and stomach to tell him the time for lunch.

average) solar day is determined by taking the proper fraction of a year as a standard day. This way, the actual day can slow up if it wishes, but it will have no effect on clocks now related to the broader base of an astronomical year. Until nine years ago, Bureaus of Standards everywhere recognized as the fundamental unit of time the Mean Solar Second, which is 1/86,400 of the Mean Solar Day (the actual day, after corrections are applied for the polar motions and inertial rotational irregularities.)

The real second?

As of 1955, the International Committee on Weights & Measures, Paris, re-defined the second as 1/31,566,925.9747 of a year, based on the year 1900 at the very beginning of January. This is called the Ephemeris Second, and technically the use of the word 'second' without any descriptive adjective refers to the Ephemeris Second—the implication being that this is the 'real' second.

The immutability of this 'real' second is dependent on two assumptions: (1) that the Sun's gravity field is constant with the passage of time, and (2) that the earth, moving through the zodiacal plane, will suffer no slowing due to sweeping through debris. Since neither of these assumptions is valid, it must follow that the second as now adopted by the International Committee on Weights & Measures, although considerably more stable than the old Mean Solar Second, is not exactly airtight itself.

On what can we base a second that would leave it eternally unchanged? The Sun's gravity field cannot be constant because the sun, like any incandescent body, is diminishing in mass, and hence gradually losing its gravitational grip.

But what about gravity itself, once corrections for such variables as mass-loss are applied? That is our next basis for time measurement.

3. *Gravitational Time.* It is certainly possible to work with the principle of gravity through clocks not affected by the melting away of incandescent gravitating bodies. For example, the period of a pendulum. But how to prove that gravity itself is an unchanging force even in a field surrounding a cooled body such as the earth.

4. *Electric Time.* Quartz crystals, ring crystals, oscilloscopes, decimal counters and beat counters provide clock movements of high precision. But quartz crystals tend to sharp with age. They vibrate more rapidly the older they

get. The best crystal oscillators will vary up to 1/50,000 second per day. Some counters have been refined to hold to about one part in one trillion in frequency.

5. *Nuclear Time.* For some time, it has seemed to science that if there exists a perfect clock, it is the atom. Periodicity of atomic nuclei appears to be not only truly universal but eternal.

Now here is the opportunity to test whether over a period of time there is any divergence between the rate of gravitational time and that of nuclear time.

Well, it looks as though there is. Damn! The amount of gravity per unit mass of matter appears now *not* to be constant. This pretty much leaves the field clear for the atom to be the ultimate clock. Sixteen years ago with ammonia and a dozen years ago with the element caesium, atomic clocks of a highly sophisticated nature were created, capable of less than one second of error in 320 years.

By 1970, a determination should be possible showing the divergence between gravitational time and atomic time with considerable accuracy.

Then with a number of functioning atomic clocks to tick away endlessly, we should be on sure ground with an absolute frame of time.

Except for one thing.

Could the frequency of the ammonia clock change with respect to the caesium clock over a period of time?

Atoms vs. stomach

There is reason to think the atomic elements are not necessarily locked in synchronization. Experiments will soon be made to detect the existence of divergence here. Then which element will be the "right" clock?

Beats me.

But I'm not going to worry about it right now, because the sun seems pretty high in the sky and this agrees exactly with a clock in my stomach that tells me it's time for lunch.

Watch that dog

Your dog could cause your death—if you let him wander around woods and suburban areas. He stands a chance of being bitten by rabid animals which sometimes lurk on the outskirts of big cities. More than 3,600 cases of animal rabies were reported in 1963, according to the Public Health Service, and the figure is climbing. States hardest hit have been Tennessee, Virginia, Texas, Iowa, Minnesota, Missouri and Ohio.

People who have to submit to treatment against rabies after being bitten by dogs are facing a serious danger. The treatment is undesirable and hazardous because it may result in encephalitis—a deadly brain inflammation. The answer? Strict enforcement of dog immunization—and more leashes.

Man's new pygmy ancestor

For years the Leakeys have been expanding our picture of man's evolution.

Their latest addition to our increasingly cluttered family tree of possible ancestors and near relatives was revealed recently by Dr. Louis Seymour Bazett Leakey.

The new "man" is officially known as *Homo habilis*, a short, upright, small-brained toolmaker. The name was taken from the Latin meaning "able," or "handy."

Dr. Leakey announced the discovery at the National Geographic Society in Washington, D. C., which supports his work.

Remains of *Homo habilis* were

Left: Dr. Lewis S. B. Leakey.
Below: Fragmentary Homo habilis fossil skull compared with skull of modern man.
photos © National Geographic Society

found by Dr. Leakey and his wife Mary in the fossil-rich Olduvai gorge of Northern Tanganyika, the site of other spectacular Leakey discoveries. Fossil parts of five individuals, including a young woman and child, were unearthed over a period of four years in different deposits at Olduvai, representing a geological time span estimated to cover more than a million years.

Dr. Leakey believes that the oldest of the specimens lived almost two million years ago.

He says, "It now seems likely that the species of present day man, *Homo sapiens,* is more likely to have evolved in Africa from *Homo habilis* than from some of the other hominids of the *Pithecanthropine* type in the Far East."

Not all anthropologists agree. Although they consider the finds important, some feel the fossils are still too fragmentary to definitely assign them a place as man's ancestor. The Leakeys themselves have already changed their theories once.

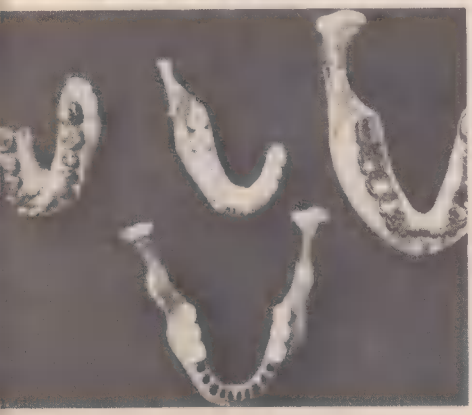
In 1959, the Leakeys discovered another type of hominid, *Zinjanthropus,* in Olduvai Gorge. This fossil was dated by the potassium-argon method as 1,750,000 years old. At first, the Leakeys felt they had found man's oldest ancestor.

Older deposit

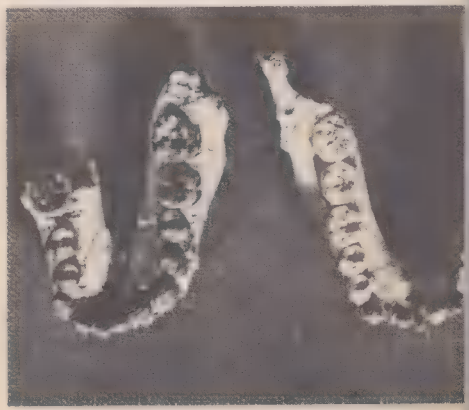
During excavations in 1960 and 1961, they found the lower jaw of a child and parts of its skull and hand, as well as a foot attributed to an elderly woman. These were in a deposit lower, thus older, than that of *Zinjanthropus.*

The child, though older than *Zinjanthropus,* was much more advanced. Strikingly different were the characteristics of the teeth. At the time, the Leakeys were unwilling to give a scientific name to the

Jawbones of Homo habilis (upper left and center), compared with Zinjanthropus jaw (upper right), and of modern man (bottom).



Two Homo habilis jawbones. The jaw at left came from a child of about 11; the right jawbone is that of a female 20 or 21.



Olduvai Gorge, Tanganyika, is one of the richest fossil beds in the world. At this site in the gorge, Homo habilis was found.

new hominid, though they expressed the belief that it was related to present-day man.

Zinj was downgraded as a direct ancestor of man when the Leakeys' 19-year-old son Richard found a *Zinjanthropus* jawbone in a more recent deposit.

Said Dr. Leakey: "The jawbone shows us that this type of Australopithecine (near man) continued to evolve practically unaltered for a very long period. It did not—as we once believed—gradually evolve in the direction of *Homo sapiens*."

Both *Homo habilis* and *Zinjanthropus* were tool makers. But *Zinjanthropus* dropped out of the picture, as did contemporary South African Australopithecines to which he seems closely related. It would appear that nature experimented with these manlike creatures, found them wanting, and rejected them.

As reconstructed by the Leakeys, *Homo habilis* was smaller than the present day pygmy, but manlike in most of his known characteristics. "The skull wall is very thin and has a rather small brain capacity, but in its morphological character, it resembles a small skull of *Homo sapiens* more than anything else," Dr. Leakey says.

The jaw and upper and lower teeth of the new species recall primitive *Homo sapiens* and are not like those of the near-men.

Also the manner in which *Homo habilis'* teeth were worn is significant. He apparently had a softer diet, which probably included the flesh of small game. The massive teeth of *Zinjanthropus*—with whom he must have lived side-by-side—were ground down by a coarse plant diet that probably included gritty roots.

Near Olduvai, Dr. Leakey also discovered a rough circle of loosely piled stones in the same geological stratum as the bone site. He says:

"It seems that the early hominoids were capable of making rough shelters or windbreaks and it is likely that *Homo habilis* may have been responsible."

Although Dr. Leakey's interpretation may be disputed by some of his colleagues, his reputation as a fossil hunter is held in awe. Faced with a desolate gully in the desert, they say he sniffs expectantly, pushes his spectacles up to the top of his head and walks off, returning shortly with a prehistoric handax or a shattered jaw bone.

He has done it again.

Photos: Bruce H. Frisch

Jonas'-eye view of Constellation as workmen put part of $300,000 worth of loving care into a yacht that may not even make the final race for the America's Cup in September.

The race against the rule

With a combination of science, intuition and money, American and British yachtsmen are ready to race again for their top trophy, the America's Cup.

by Bruce H. Frisch

THE designer of a 12-meter America's Cup yacht is like a belly dancer in a cast-iron Mother Hubbard. He is trying to turn out a racy boat according to cast-iron rules meant to keep it wholesome.

So with T-square and slide-rule he probes the rules for soft spots. As soon as he finds a loop hole, it is plugged.

Back in 1930, designer W. S. Starling Burgess saved a lot of weight by switching from a hollow wooden mast to a streamlined one of aluminum. Thereafter, it was ruled, a mast had to weigh at least 1,500 pounds more. The result was to encourage careful attention to scores of niggling little details, many intended to save weight.

Yet, beginning with Olin Stephens' *Vim* in 1939, 12-meter boats have deliberately been built heavier and longer, demonstrating that the

location of the weight is more important than the amount of weight. If it is in the lead ballast at the bottom of the deep keel, that is good. But the higher a pound is, the more it hurts. Weight at the bottom of the keel helps counteract the heeling force of the wind, while all weight above the boat's center of gravity, which is somewhere in the hull, pulls the boat over further.

The ideal boat would stand straight up and down all the time. When it heels, less of the wind's force is directed into pushing the boat forward. At the same time, a hull tilted over 30 degrees requires about 15 percent more push to get it through the water at the same speed. Thus, designers will go to absurd lengths to save weight anywhere, but especially up on the deck or mast, and add it to the 36,000 pounds of lead ballast.

The bare essentials

On the 1962 entry, *Nefertiti,* Ted Hood used a fiberglass sink, left doors off the crew's lockers, cut bolts short and eliminated a 20-pound pedestal from the 59,500-pound boat by attaching the helm directly to the steering mechanism.

Raymond Hunt, trying to turn the 1958 also-ran, *Easterner,* into a 1962 contender, prescribed a titanium boom to save an expensive 100 pounds.

The hull has had the most intensive development of any part of the boat, but all sizable gains in speed have been wrung out of it by now. Most of the wringing has been done in the 140-foot tow tank at Stevens Institute (no connection with designer Olin Stephens) of Technology in Hoboken, N. J. Every U. S. Cup hull, beginning in 1937, and many of the challengers' boats have been tested there.

A designer sends data to Pierre DeSaix, who runs the tank, from which the model shop carves a five-foot pine model in ten days.

The model is then towed the length of the tank at various speeds and the force to pull it measured. In most towing tanks a hull can only be towed upright pointed in the direction it is moving. This is adequate for power-driven vessels, but not for sail boats. What helps make the Stevens Tank No. 1 the principle place for Cup testing is that it has the equipment to tow a hull heeled over at an angle and pointed in a slightly different direction than it is going—the actual conditions of sailing.

From the results of the first runs the designer determines what changes he wants the model shop to make in the hull for a retest. The cycle is usually repeated six to eight times before the designer either is satisfied or runs out of time.

Stevens has deliberately kept its setup simple, and the personnel have their routine down pat. DeSaix can deliver results within two weeks on the first round and within a few days on subsequent changes. From last September through January the tank was going ten to twelve hours

a day, seven days a week on Cup hulls. Last-minute work continued well into the spring.

Bill Luders had been developing a design in the tank ever since 1957, before the first post-war race. Last September, he began testing in earnest after finally getting an order to build *American Eagle* from the Aurora syndicate headed by Pierre S. (Pete) du Pont. The boat was built at Luders Marine Construction Co., Stamford, Conn.

Olin Stephens, designer of a past America's Cup winner, got an order for a boat as late as last August from a New York syndicate led by Walter S. Gubelmann. Stephens, however, had plenty of experience to fall back on. Besides *Vim,* Stephens had designed *Columbia,* the winner in 1958. Thomas Patrick Dougan of Newport Beach, Calif., bought *Columbia* in April with the intention of racing, giving Stephens two entries in the trials. His new boat, *Constellation,* was built in the Minneford Yacht Yard on City Island, New York City.

DeSaix has also been testing a holdover from 1962, *Nefertiti.* Ted Hood, the Marblehead, Mass., sailmaker who designed her, was mostly limited to fussing with the keel. He also padded out the already hefty hull.

The full course of testing costs $20-25,000. While this sounds high, the Stevens rate of $25 an hour for the tank is low and is another reason

The story of the America's cup

The America's Cup Races started with a bad gamble by a syndicate of New York yachtsmen. The Crystal Palace Exposition was being held in London in 1851. Preliminary soundings led Colonel John C. Stevens and five friends to believe there would be big prizes and fat side bets to be won in British yacht racing that summer, so they built the two-masted schooner *America* and sent her over to clean up.

Soon after she got there, *America* sailed an impromptu race with a British yacht and won easily. Word got around and Stevens challenged for big stakes—in vain. But he did enter an open regatta of the Royal Yacht Squadron around the Isle of Wight and beat everything in sight to take a bottomless silver ewer which became known as the America's Cup. Stevens turned the Cup over to the New York Yacht Club as a prize in a challenge race open to any yacht club in the world. England, Ireland, Scotland, Canada and Australia have tried and failed to take the Cup away in 18 races beginning in 1870.

Over the years, Stevens' original flexible rules have been changed several times. In the '30s, the rules allowed use of J-class boats under the Universal Rule rating system. They were about 76 feet long at the waterline (l.w.l.). In the '50s, it was estimated it would cost two to three million dollars to build and race one boat for a year. The rules were altered in 1956 to allow boats as short as 44 feet l.w.l. to challenge. However, by common consent of the challengers and the NYYC, the America's Cup is actually contested by boats that belong to the 12-meter class as defined by International Rules (about 46 feet l.w.l.).

why the Institute gets almost all the work.

These four boats, *American Eagle, Columbia, Constellation* and *Nefertiti,* will battle it out in trials which were scheduled to begin in June and run through Sept. 6. One will be chosen by the New York Yacht Club selection committee to defend the Cup against a British challenger in a best of seven series off Newport, R. I., starting Sept. 15.

Both of the possible British challengers, also spring from tests in the Stevens tank. David Boyd, designer of the 1958 challenger, *Sceptre,* tested from June 1961 to June 1962. When he had finished, relates DeSaix, "I said, 'You have enough information to build two boats.' He winked, and that's what he did." *Sovereign* was launched in 1962. Some British yachtsmen didn't think she was good enough and talked two Australian sheepmen, the Livingston brothers, into paying for the building of an improved version of *Sovereign, Kurrewa V.*

One reason the Livingstons agreed was that they had test data of their own they wanted to use before it got stale. Lacking a suitable tank, they had built 1/9th-scale, radio-controlled models and sailed them on an English lake. "Most people write us off as a little mad," Frank Livingston says.

With all the designers converging on the Stevens tank at Cup time, DeSaix often has a traffic problem. He has to hustle one designer out the back door as another comes in the front, and slip the last-tested model out of sight.

Usually these men are trying to get their boats to perform best at wind speeds over 12 knots. DeSaix estimated in 1962 that 12-meter yachts were 10 percent faster than 30 years before and that the possible additional gain was about five percent. "A turning point in a hull

Designer Olin Stephens, left, thrashes out a tough point with construction supervisor Paul Coble during building of Constellation. Stephens also designed the 1958 winner.

Pierre DeSaix sprints along taking an instrument reading as a model of Nefertiti is towed through the 140-foot-long tank at Stevens Institute of Technology, Hoboken, N.J.

program would be a one percent improvement," says DeSaix.

Working with such small margins means the testers have to watch tiny details. Enough dust collects on a model over night to raise hull resistance by one percent. If the model's yellow varnish blisters, resistance can jump three percent.

In 1962 DeSaix claimed he could pick the winner by the results of the tank tests. This year he says, "I'm a little older and wiser. I *think* I know who's best." But he can't tell.

Like handmade furniture

Building takes seven months or more and $300,000. The terrific price is easy to understand when looking over *Constellation* at the Minneford Yard. "She's like a piece of fine, handmade furniture," says construction supervisor Paul Coble. "Some of the tools and methods of construction haven't changed since Noah's ark, I guess."

What's more, *Constellation* is all curves. The hull is double-planked of mahogany. You can draw a fingernail over the outside and never know there is a joint in the whole thing.

On many construction details the designer has little choice. The rules specify, for instance, the frame spacing, density of woods, that there be three metal frames, and the size of the lightening holes allowed. Relieved of the rules, builders might not change much. "Builders are conservative. The sea is hard," explains Coble.

After the hull is complete, the extruded, hollow aluminum mast is raised, the specially made winches installed, specially made, lightweight blocks rigged and the $50,000 suit of sails stowed below.

Sails provide the power to overcome hull resistance and wind resistance. Compared to the effort put into reducing resistance, little systematic research is done on sails. The designer devises a pretty standard rigging plan and has Ted Hood make the sails. Almost everyone buys Ted Hood sails.

Since the war, sails of synthetics have replaced Egyptian cotton. They are lighter for the same strength,

thus saving weight high up where it counts most.

Another sail trend started the whole movement toward heavier, longer Cup racers. The 12-meter formula charges for sail area. It's a measure of the powerplant. But for forward sails the designer is charged only 85 percent of the area. By taking advantage of the rule with large, overlapping jibs, designers gained more power. To get more speed from their new power they had to make the boats two feet longer, since a displacement hull has a top speed proportional to the square root of its length. For 12-meter boats, approximately 46 feet long at the water line, the limit is about eight knots.

A workman smoothes the lead ballast on Constellation's bottom. Stephens hopes to cut hull resistance two to three percent by shaping the lower edge into a vee like a meat cleaver. David Boyd adopted the idea for his British challenger, Sovereign.

The designer's wriggles

The rules also require a minimum weight per foot of length, so the boats had to be made heavier. Naturally, an increase in length forced a decrease in sail area, but there was a net gain in speed. (The story doesn't end here. The whole sequence was explained by Philip L. Rhodes, designer of *Weatherly*. It is a good example of the designer's wriggles. A longer boat heels less for the same width. When designers hastened to slim their boats, the rules committee slapped on a minimum width. Elbow room is limited in the direction of a lighter boat as well. There is a minimum weight of 55,000 pounds.)

The mainsail has been shaped by a trend toward higher, narrower sails that reached its peak in the '30s. Designers wanted to crowd more of their limited sail area near the leading edge, or luff. As on wings, which sails resemble in many ways, this area contributes the most push. The same reasoning is behind the U-2's long, slender wings. The high sail has the additional advantage of reaching up into stronger winds. The rules committee reacted by limiting the height of the mast above the deck to 82 feet. Designers bounced back by giving the deck a high crown, only to be thwarted once more by a rule setting a limit of seven inches on the crown.

Even more speed could be gained if designers would reveal their jealously guarded actual performance

for comparison with tank results.

A more adventurous tank-testing program might pay off in larger speed gains. DeSaix would like to see the testing of whole families of models to explore the limits of present trends and the effects of radical departures.

DeSaix has spotted other neglected angles. He feels sure that if all the designers would combine the results of their tests, most of them right in DeSaix's file cabinet, they could get an immediate jump in performance. "Many times I have to do tests that I know won't work, because I have done them for someone else, but I can't say anything," DeSaix complains.

A sail is a sail

In spite of their similarity to wings, little is done to test sails in a wind tunnel the way hulls are tested in a tank.

Stephens sees mostly "expense and difficulty" in such a program.

"The British have done a lot more sail testing and may come up with some improvements, but until I see them I'll continue to believe American sails are better."

With the cost of a Cup campaign running around $500,000, designers probably can't get owners to stand still for such a plan, DeSaix guesses, at least until America loses the Cup.

Perhaps, though, yachtsmen are not really interested in technical progress. Their rules are certainly meant to stifle it. On the other hand, complete freedom for the designer "is a silly concept," says Stephens. "You'd come right up against whatever the limits might be."

In exchange for stifling technical innovation, the 12-Meter Rule is supposed to promote the building of an all-around useful boat. "That was true when the Rule was framed," says Stephens, "but not today. These are strictly racing boats." A rule that really worked that way would be good, he feels. "I'd like to see a formula which would allow more leeway for owners. Individuals rather than syndicates might be attracted if the boat could be used for other kinds of racing and for cruising."

Yachtsmen are more interested in the sentimental side of the race. For them the trophy is a Cup of nostalgia. As Bus Mosbacher, skipper of *Weatherly* in 1962, said, "[The Cup] is one of the few things left in this world that's a symbol of the way things used to be."

ANTIBIOTICS taken during pregnancy have caused tooth discoloration and defects, report Allen H. Kline, M.D.; Russell J. Blattner, M.D., and Martin Lunin, D.D.S. in the *Journal of the American Medical Association.* Abnormal teeth were found in seven children whose mothers had taken tetracycline after the fourth month of pregnancy. The affected teeth, the doctors say, showed yellow fluorescence, indicating tetracycline deposits in calcifying tissues.

Wide World photo

Out from hiding in its hangar at Palmdale, Calif., the B-70 was viewed by the public for the first time May 11. Painted white to reflect back friction heat, the plane is 185 feet long and has a wing span of 105 feet. It will fly at altitudes above 70,000 feet.

Flying patent factory

WHAT could be described as the biggest and most expensive white elephant in aviation history was finally rolled out for a public viewing in May. It is the B-70, a 2,000-mile-an-hour, 275-ton plane that has already cost close to $1.5 billion.

The mammoth craft will begin its test flights later this summer.

Since the beginning, the B-70 has been beset by political and technical troubles. It became a rallying point for those who felt that the nation was neglecting manned bombers and relying too much on missiles.

Technical troubles cropped up in trying to make the fuel tanks leakproof at the 650° flight temperature.

The B-70 was first conceived back in 1955 as a long-range bomber, but today almost no one believes it will be manufactured in volume. There are now two experimental models and that is probably all there will ever be.

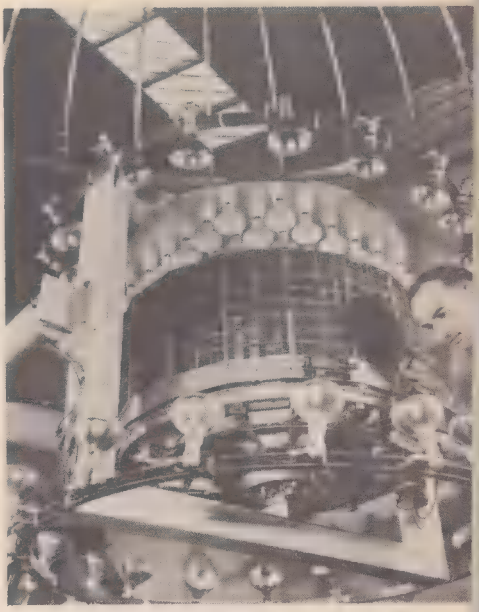
But the B-70 is not headed for oblivion. The plane incorporates enough new technology to have resulted in 1,000 patent applications. Much of this technology will help speed development of other advanced military craft.

Also in the future, information gained from B-70 tests will make vital contributions to supersonic commercial airliner.

A white elephant it may be, but its value as an engineering trial run may be worth a lot of ivory.

Magnets

METALS THAT ATTRACT METALS

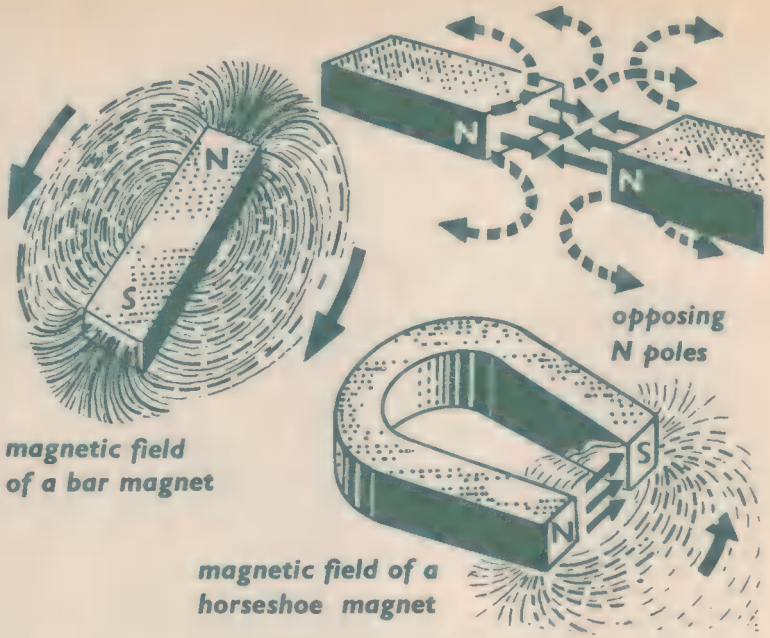


Satellites are tested in spherical "cages" that duplicate the earth's magnetism.

THE word magnet comes from Magnesia, a place in Asia Minor where lodestone was found. Lodestone is an oxide of iron known to mineralogists as "magnetite," and it possesses the power of attracting pieces of iron and holding them to its surface. The Chinese are believed to have known the peculiar properties of lodestone long before the ancient Greeks, and to have discovered that if a piece of lodestone is suspended by a thread it turns so that one end of it always points to the north. They made use of this when they invented the compass.

It was later discovered that if a piece of steel is rubbed with lodestone it also acquires the power to attract iron, and is therefore called a magnet. Steel and lodestone retain their magnetism permanently, but though pure iron can be magnetized it loses its magnetic power very quickly. Permanent magnets can be made of the metals steel, cobalt, nickel and manganese, and very strong magnets can be made of special alloys, some of which contain no iron at all.

The first scientific study of magnetism was made by Queen Elizabeth I's physician, William Gilbert, in the sixteenth century. He made pieces of steel into magnets by stroking them with lodestone, and found that they showed most of their magnetism at their ends, which he called "poles."



The ends, or poles, of magnets have the strongest magnetism. These poles are called N and S. The law of poles is that like poles repel one another; unlike poles attract.

We can see this for ourselves, for if we bury a bar magnet in iron filings and then lift it out, most of the filings cling to the ends. Dr. Gilbert made a number of experiments with magnets. He found that they had two poles, and that when a magnet was held up so that it was free to turn, then it always came to a rest pointing in the same way. One end of the magnet pointed north, and to this end he gave the name of "north-seeking pole," or just simply N pole, and the other end, which pointed south, he called S pole.

Another very important discovery of his was the Law of Poles. He found that when the N pole of one magnet was brought near to the N pole of another magnet, it was pushed away or repelled. He found that the same thing happened with two S poles, but that N and S poles attracted each other. This law of poles can be put very simply. Like poles repel; unlike poles attract.

Many of us have lifted a number of soft iron tacks with a magnet, and we have noticed how they will hold on to one another to form a long chain of tacks. None of these tacks were magnets to start with, but when they were brought near to the magnet, and were pulled towards it, they became magnets themselves. Each tack magnetized the one below it. When the magnet was taken away, the tacks fell apart, because they were made of iron and

Horseshoe magnets are strong because their poles are near one another.

were unable to retain their magnetism. This little experiment shows that a magnet can create—or "induce," as we say—magnetism in magnetic substances, such as iron or steel. The creation of magnetism in a piece of iron or steel by another magnet, is called "magnetic induction."

Temporary magnets

We already know that soft iron can only be magnetized temporarily by induction, and if we wish to make permanent magnets we need hard steel or steel mixed with metals like nickel and cobalt. One way of making magnets is by drawing one end of a magnet along a piece of hard steel, and then repeating this motion several times, taking care always to do it in the same direction, and never to rub backwards.

Other methods may be used, such as laying a bar of steel in a north-south direction and hammering it several thousand times. The strongest permanent magnets are made by passing an electric current through a coil of wire around a bar or rod of hard steel. If soft iron is used instead of steel, it stops being a magnet as soon as the current is switched off, because (as we may remember) soft iron can only be temporarily magnetized.

If we wish to find out if a substance is a magnet or not, we only have to hold another magnet near it. If it is merely a piece of iron or unmagnetized steel, both ends of it will be attracted. But if it is another magnet, one end of it will be attracted and the other end repelled.

If we cut a magnet in half we find that we make two magnets, and the same happens if we cut it into four or more parts. We find that we cannot have just an N pole; if we cut off the N pole, the end where it was attached becomes a new S pole, and a new N pole appears on the cut end of the original magnet. Small magnets made by cutting up a big one in this way are much weaker than the original magnet.

The real reason that iron or steel becomes magnetized is not fully known, but it is thought that unmagnetized iron or steel is made up of a large number of molecules mixed together without any order. Each molecule is itself a little magnet, and when the iron or steel is magnetized the molecules swing in-

The earth itself is a huge magnet and is surrounded by a magnetic field in space.

to line so that all their N poles point one way, and all their S poles the other.

If we heat a magnet until it is red hot, the molecules lose their arrangement so the magnetism is lost.

The space around a magnet which is affected by magnetism is called the "magnetic field." We may have seen pictures of magnetic fields made by scattering iron filings on a piece of drawing paper laid over the magnet. The filings arrange themselves in directions which show the distribution of the magnetic field. Such directions are called "lines of force."

The lines of force of a bar magnet cluster near the ends or poles, and these poles are of equal strength. When two N or two S poles are opposite, there is a space about halfway between the two poles where there is no magnetism. This space is called the "neutral point," because there the two poles cancel out one another. Horseshoe magnets make very strong magnets because the poles are near each other.

Bar magnets and other magnets gradually lose their magnetism if they are not kept carefully, and "keepers" are needed to stop it from happening. These are made of soft iron and when put in the right position on the poles they help to keep the molecules of the magnets in magnetic order.

The earth itself behaves as if it were a magnet. It is as if there were a huge bar magnet passing through the center of the earth with one pole near the N and the other near the S geographical pole. This accounts for the behavior of the compass. The magnetic compass has been in use for centuries. It is just a magnetized needle free to swing around so that it lines up with magnetic N and S. In an elaborate ship's compass great care is taken to allow the magnets to swing freely, and sometimes several magnets are attached to the compass-card which is then floated on mercury. But most steel ships and aircraft nowadays use gyroscopic compasses, which do not employ magnets.

In the modern world magnets are needed for many purposes; they are used in telephones, radio, and television sets, for example. They are needed, too, in electric bells, motors and electric generators. The study of magnetism has become a very important branch of the science of electricity.

★ ★ ★ ★

A NEW kind of safari has been organized by a group of Johannesburg, South Africa, doctors. The doctors have invited 100 smokers who want to kick the habit to go on the trip in the hope that getting away from civilization will reduce the urge to smoke. For one thing, they won't be able to sneak around to the corner drug store to buy a pack. The doctors will conduct scientific studies of the physical and mental condition of the subjects and will also lecture on general health problems.

the progress of MEDICINE

What Causes Blindness

by Arthur J. Snider

MANY persons think blindness results chiefly from injury. Only 5 percent of all blindness occurs in this manner. Ninety-five percent results from diseases most of which cannot be treated, because science has not yet discovered their causes.

The key to blindness prevention is in the hands of the scientist, says Dr. Thomas D. Duane, professor of opthalmology, Jefferson Medical College, Philadelphia.

Dr. Duane has just visited more than 100 institutions and research laboratories to determine the state of ocular research in this country. He finds the groundwork is being laid for a massive assault on eye disease which causes 30,000 new cases of blindness a year.

Diagnostic techniques are being perfected. Hitherto unobservable changes in the retina can now be studied by the introduction of dyes which circulate through the blood vessels.

Advances in the transplanting of corneas are taking place. Plastic corneas are being perfected which hopefully may soon be employed where standard transplants have failed.

Eye researchers have found that the use of drugs, such as the steroids, may be a double-edged sword that can aggravate the blindness-causing disease glaucoma.

A new development in eye surgery, called cryosurgery, adapts freezing techniques to the delicate needs of the eye surgeon in dealing with glaucoma, cataracts and—most promising of all—the treatment of retinal detachments.

The studies of chemical composi-

tion of the lens of fishes and lower animals are leading to new knowledge of evolutionary relationships in nature.

There has been a 128 percent expansion of eye research laboratory space in the last five years, but in many cases laboratory conditions were grossly inadequate. In even progressive laboratories, Dr. Duane found a half-dozen researchers and assistants working elbow to elbow in tiny rooms hardly suitable for two.

As the eye researcher delves deeper and deeper into eye pathology, the electron microscope is becoming one of the essential tools. Yet today there are only 14 electron microscopes in use in eye research laboratories in the United States. Twice as many are needed.

Dr. Duane's survey was made in behalf of Research to Prevent Blindness, Inc., a voluntary foundation.

Who needs physical fitness?

On the subject of physical fitness and exercise, a medical specialist asks: Who needs it?

Athletic and physical fitness programs today are in danger of becoming a patriotic enigma wrapped in tradition, misinformation, foggy thinking and old wives' tales, says Dr. Frank P. Foster of the Lahey Clinic, Boston.

He points out that few youngsters being subjected to physical fitness pressures will become professional athletes. Most of them will go into a business or profession with little time left for athletic effort except on weekends.

Writing in the *New Physician*, Dr. Foster punctures a number of pet concepts. He says:

It's a fallacy that the physically fit boy inevitably becomes a healthy man. Physical fitness and health are not interchangeable. A competent swimmer is not necessarily healthier than a boy who has lost both legs in an auto accident.

The claim that the physically fit athlete is an extra good student is not always borne out. He may be so tired by his sport as to become a sleepy, listless student.

Exercise is not essential to longevity. Many people who exercise little live to the ripest of old ages. Women who rarely engage in competitive sports generally outlive men.

The "weird concept" that big muscles are in some way good is false. They may be a hazard. Bulging muscles frequently change into bulging fat in later years.

The "puzzling idea" that good sportsmanship can only be derived by participating in athletics is far from true. It is not recorded that Lincoln, Luther or Schweitzer ever played on the varsity.

Like academic courses, physical fitness training should prepare a young man for his future, says Dr. Foster. It should provide experience that increases his capacity to think and act under pressure and hold his temper under stress. It should provide him with athletic skill for business use and family sports he can do with his wife and children, such as horseback riding, golf, hunting, tennis or plain hiking.

New consideration should be given to the non-athletic boy. If he prefers a hobby of bird watching or building a hi-fi set, let him. His future health, says Dr. Foster, may depend more on being a skillful automobile driver than on his ability to play first base.

The 'good old days' are good

Old folks who want to sit down and reminisce about days gone by should be encouraged to do so as a depression preventive. Dr. Arthur W. McMahon of the Age Center of New England, Boston, says it's a mistake to regard dwelling on a bygone era as a sign of intellectual deterioration.

Reminiscing is prophylactic, Dr. McMahon says. It helps the older person preserve his self-esteem and a sense of continuity. By glorifying the past and depreciating the present, as is often done in reminiscing, an oldster obtains a "halo effect" that makes him feel he has been part of the best and has nothing to regret.

Reminiscing also helps him feel he is making a contribution by bringing the knowledge of the past to the present, even if the truth is stretched a little.

In older societies, Dr. McMahon notes, an oldster was an important source of information and instruction. If the story-teller was particularly adept, he was also a source of entertainment. The development of science and modern methods of communication have contributed to a decreasing respect for reminiscing in the aged. Today anxious relatives often discourage this behavior, because they consider it a sign of deterioration in their loved ones.

With the steadily increasing numbers of aged in our modern society, it seems essential to Dr. McMahon that new ways be found to provide opportunities for the aged to contribute their knowledge of the past, especially since it seems to be so significantly related to successful adaptation.

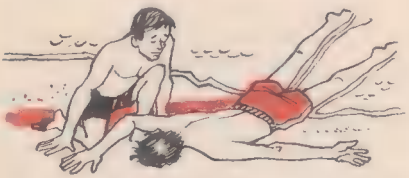
Underwater blackout

A 16-year-old boy was pulled from the bottom of a pool after he had stopped breathing. Fellow swimmers applied mouth-to-mouth resuscitation and then took him to a hospital. When he was seen in the

emergency room, his skin was cold and bluish. He was restless, his respirations were labored, and he responded sluggishly to commands.

The next morning, the boy was improved and was able to tell his story. He had sought to better his previous record of swimming four widths of the pool underwater before coming up for air. Before diving in, he had gone through an overbreathing exercise (hyperventilation) to increase oxygen content and reduce carbon dioxide in the blood stream.

He had swum only 3½ widths when he blacked out. But he felt no sense of urgency or impending doom. His discomfort was not enough to cause him to surface. His next memory was of moving from the stretcher to the examination table in the emergency room.



In relating the incident in the journal *GP*, Dr. Anna P. Dumitru of Huron Road Hospital, Cleveland, said hyperventilation may be a frequent cause of drowning. Fifteen deep breaths may set the stage for an underwater blackout, she pointed out. One gets only a negligible increase in oxygen content while the reduced carbon dioxide removes the stimulus for breathing. The lack of carbon dioxide acts directly on the tiny arteries of the brain, causing them to constrict and reducing the blood flow by as much as one-third.

Your ear tests your lungs

The patient, comfortably clothed, sits on a firm chair. A headpiece, similar to that used as radio earphones, is placed on his head. Inside one earphone is a device for drawing a tiny amount of blood from the ear and subjecting it to photo-electric analysis for oxygen content. The patient is tested under a resting condition and then told to hop up and down a step for five minutes of exercise. The blood again is sampled, and the amount of oxygen noted.

This simple test tells physicians quickly how the lungs are functioning on the basis of the amount of oxygen they are able to put into the blood stream when the demand is great.

Dr. Louis J. Pecora of Cincinnati said the simple, portable device is excellent for screening large numbers of persons.

Gelatin useless for nails

Grandmother has contended that eating gelatin will correct brittle fingernails. Dr. Albert M. Kligman, Philadelphia dermatologist, doubts it. Gelatin is a protein, he points out. People with brittle nails have no known protein deficiency, and if they did, the nails would be among the last objects to be involved. Any protein would be as effective.

Tidal waves generated by the Alaska earthquake wrecked boats docked at Kodiak, Alaska.

DANGER: TIDAL WAVE!

When an earthquake is big enough to start a tidal wave it is up to an almost unknown government agency to sound the warning. Here is what happened in the dangerous hours following the Good Friday Alaska earthquake.

by Stacy V. Jones

THERE is no quieter place than one of the Coast and Geodetic Survey's magnetic observatories. Visitors are told to park their cars, and even their pocket knives, far enough away to avoid bothering the instruments.

Late in the afternoon of Good Friday, 1964, the scientific calm at the observatory in Fairbanks, Alaska, was shattered by an alarm bell. It meant that the seismograph had registered an earthquake big enough to start a sea wave.

John B. Townshend, the observer in charge, began preparing a message to the Honolulu observatory, center of the network that spreads sea wave warnings. As he glanced out of the window, he saw the flagpole swaying in widening arcs.

Seismic sea waves, or tsunamis (their Japanese name), are a source of dread and black headlines around the vast Pacific Ocean rim. In 1960, one that started off the coast of Chile killed 61 people in Hawaii and did $22 million damage there, despite six hours' warning.

At Townshend's station, the Good

Friday quake was recorded shortly after 5:37 p.m. About seven minutes later a seismograph alarm sounded at the Honolulu observatory, alerting Robert A. Eppley, the seismologist, and other members of the staff.

They knew that a heavy earthquake had occurred, but they did not know where. If the source, or epicenter, was in the ocean floor bordering the Pacific, a dangerous wave was likely.

Eppley sent messages to observatories in Fairbanks and Sitka, Alaska; Pasadena and Berkeley, Calif., and Tucson, Ariz., asking for immediate readings. Similar messages went to Guam and Tokyo.

Townshend, at Fairbanks, did not get the message, nor did his own report reach Honolulu. At 6:36, the Federal Aviation Agency told Honolulu that the cables to Alaska had been broken.

Meantime, earthquake readings reached Honolulu from Manila and Hong Kong. The distance of the epicenter from a recording point is measured by comparing the arrival times of two vibrations or waves that pass through the earth's interior. The faster one alternately compresses and dilates the rock through which it travels; the slower one shakes the rock sidewise as it advances.

When a seismologist knows the distance an epicenter is from several different points, he can tell its location by triangulation. This is generally done on a globe by tracing the arcs until they meet.

A little information began trickling in to Honolulu from Alaska. The Navy's fleet weather central reported tremors in Kodiak and damage to the tide gage there. The F.A.A. said the International tower at Anchorage had been demolished.

Tokyo sent readings from several cities in Japan, and asked for information. Honolulu replied that the epicenter had been determined as 61 North, 147½ West, near Seward, Alaska. The preliminary calculation of the magnitude was 8.

An intensity of 8, calculated on the Richter scale, means a great earthquake. The scale, invented by Charles F. Richter of Caltech, is logarithmic, or more accurately, exponential. A magnitude of 8 is between 25 and 30 times a magnitude of 7. When they had more time, the seismologists redetermined the Good Friday figure as 8.5.

The busy staff at the Honolulu observatory knew the epicenter but did not know whether a sea wave had been started. If it had, it was moving at between 400 and 500 miles an hour. In mid-ocean, the distance from peak to peak might be 500 miles, and the wave would not be noticed from shipboard.

Once the sea wave struck a beach it might reach a height of 100 feet, drowning shore dwellers, tossing their boats inland, and wrecking their buildings. An hour and 18 minutes after the alarm bell, the observatory sent Bulletin No. 1 to the Navy, F.A.A. and other agencies, to be widely relayed:

"THIS IS A TIDAL WAVE (SEISMIC SEA WAVE) ADVISORY. A SEVERE EARTHQUAKE HAS OCCURED AT LAT 6IN LONG 147.5W VICINITY OF SEWARD ALASKA AT 0336Z 28 MARCH. IT IS NOT KNOWN REPEAT NOT KNOWN AT THIS TIME THAT A SEA WAVE HAS BEEN GENERATED. YOU WILL BE KEPT INFORMED AS FURTHER INFORMATION BECOMES AVAILABLE. IF A WAVE HAS BEEN GENERATED ITS ETA FOR THE HAWAIIAN ISLANDS (HONOLULU) IS 0900Z 28 MARCH."

To make sure they would be understood, the seismologists used the popular term "tidal wave" as well as the accurate "seismic sea wave." Such waves are not caused by tides. The letter Z in the figures meant Greenwich mean time. The estimated time of arrival at Honolulu would be 11 p.m. locally.

Eppley and his associates needed Alaskan tide reports to be sure whether a sea wave had been started. Not all submarine shocks create them. The only direct messages came in by radio from Kodiak, where there were no readings as the tide gage had been damaged.

Half an hour after No. 1, Honolulu sent Bulletin No. 2:

"THIS IS A TIDAL WAVE (SEISMIC SEA WAVE) INFORMATION BULLETIN. DAMAGE TO COMMUNICATIONS TO ALASKA MAKES IT IMPOSSIBLE TO CONTACT TIDE OBSERVERS. IF A WAVE HAS BEEN GENERATED THE ETA'S ARE ATTU 0745Z. . . ."

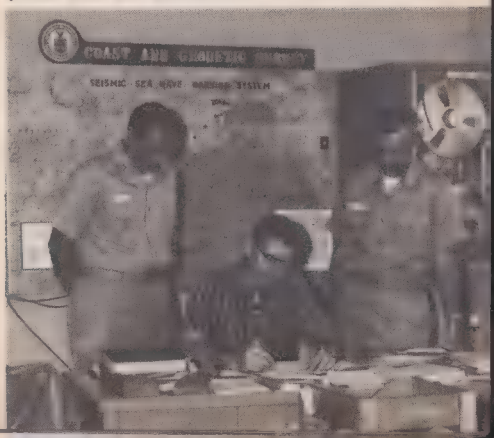
There followed estimated arrival times for Adak, Dutch Harbor, Kodiak, Samoa, Canton, Johnston, Midway, Wake, Kwajalein, Guam, Tokyo, Sitka, San Pedro, La Jolla, Balboa, Acapulco, Christmas, Crescent City, Legaspi, Neah Bay, San Francisco, Tahiti, Tofino (B.C.), Valparaiso, Honolulu, Hualein (Taiwan), La Punta, Marcus, Hong Kong, Shimizu, and Hachinohe.

Sitka observatory advised that a strong local shock had been felt and had knocked out some of the instruments. The first definite word of a wave came at 7:55 from Kodiak. The station had experienced a seismic sea wave, with water from 10 to 12 feet above mean sea level. Waves from 30 to 35 feet high continued intermittently.

At 8:37, Honolulu time, a little less than three hours after the earthquake alarm had sounded, a definite warning went out in Bulletin No. 3:

"THIS IS A TIDAL WAVE (SEISMIC SEA WAVE) WARNING. A SEVERE EARTHQUAKE HAS OCCURED AT LAT 6IN LONG 147.5W VICINITY OF SEWARD ALASKA AT 0336Z 28 MAR. A SEA WAVE HAS BEEN GENERATED WHICH IS SPREADING OVER THE

At the Honolulu observatory, seismologist Robert A. Eppley (center) discusses reports with his associates.



Crescent City, Calif. suffered some of the worst damage. Yet it was far from the quake center. The sole villain was the tsunami.

PACIFIC OCEAN. THE ETA OF THE FIRST WAVE AT OAHU IS 0900Z 28 MAR. THE INTENSITY CAN NOT REPEAT CAN NOT BE PREDICTED. HOWEVER THIS WAVE COULD CAUSE GREAT DAMAGE IN THE HAWAIIAN ISLANDS AND ELSEWHERE IN THE PACIFIC AREA. THE DANGER MAY LAST FOR SEVERAL HOURS. . . ."

The arrival times were repeated.

Data on wave heights came in from the Coast Guard and other sources. A quarter hour after the predicted arrival time, Civil Defense began relaying information on waves that struck Hawaii. Fortunately, these were not of record height.

At 1 a.m., Hawaiian time, on Saturday, the Honolulu observatory sent its fourth and last general bulletin:

"THIS IS A TIDAL WAVE (SEISMIC SEA WAVE) INFORMATION BULLETIN. THE LARGER WAVES HAVE APPARENTLY PASSED HAWAII. AN ALL CLEAR STATUS FOR HAWAII CAN BE ASSUMED [now]. ALL PARTICIPANTS IN THE SSWWS [Seismic Sea Wave Warning System] SHOULD ASSUME THE ALL CLEAR STATUS TWO HOURS AFTER THEIR PARTICULAR ETA UNLESS LOCAL CONDITIONS WARRANT THE CONTINUANCE OF THE ALERT STATUS. MAXIMUM WAVE HEIGHTS REPORTED BY VARIOUS MEDIA ARE: OAHU 8 FT, HAWAII 6 FT, MIDWAY 1.5 FT, KAUAI 3 FT, CRESCENT CITY 12 FT, KODIAK 30 FT, CORDOVA 30 FT, TOFINO 8 FT."

The Honolulu observatory continued receiving and supplying information, but its chief task was over.

The Good Friday earthquake ranked with the greatest since recording began late in the nineteenth century. A preliminary tabulation by the President's Office of Emergency Planning showed for Alaska 31 dead, 81 missing and assumed to be dead, 26 injured, and 500 homeless. Rough ("ballpark") estimates of property damage ranged from $350 million to $750 million. The greatest damage was from the quake itself, but heavy waterfront losses in lives and property were caused by the sea waves. For points closer than 400 miles from the epicenter, no existing warning system could have helped.

The heaviest damage was reported from coastal points in Alaska, Canada, and northern California. Minor damage was recorded along the coasts of Washington, Oregon and the Hawaiian Islands.

Crescent City, Calif., suffered the loss of 10 lives and between $6 million and $7 million in damage to private property, not including ruined automobiles. In Crescent City, far from the epicenter, the sole villain was the tsunami.

Records of the Coast and Geo-

detic Survey indicate that the California Disaster Office (Civil Defense) received the alert at 10:44 p.m., Pacific time, relayed it promptly by voice and, at 11:04 p.m., over the statewide teletype.

The first wave struck Crescent City at 12:04 a.m., but was only 3 feet high. Some residents who had gone to high ground at the first warning ventured back. The fourth wave, which struck at 1:20 a.m., was 12 feet high. It was reported to have caused all the casualties, the major damage, and the fires.

The Coast and Geodetic Survey, a bureau in the Department of Commerce, authorized by law to make investigations in seismology, has operated the cooperative warning system since 1948. It was established primarily for the protection of the vulnerable Hawaiian Islands. Two years before, on April 1, 1946, a sea wave originating in the Aleutians had caused 173 deaths and $25 million property damage in the territory. The Coast Survey noted that the wave had taken five hours to reach Hawaii, ample time to alert the coastal populations to take to the hills or to the open sea.

Audible and visible alarms are now wired to Coast Survey seismographs at Honolulu, Fairbanks and Tucson. A dozen other cooperating observatories can be called on for data. Usually the epicenter can be determined within an hour. The network also includes 30 tide stations, American and foreign, that check on the rising of the water.

Charts showing estimated travel times for sea waves originating in the Pacific rim have been drawn for 32 stations. The observer, if he knows where a wave has started, can confirm by the chart the ETA given in an alert from Honolulu.

Coast Survey officials believe that since 1948 their warning system has saved hundreds of lives and considerable movable property—boats, trucks, automobiles.

They also regard its operation on Good Friday as effective. The epicenter and the existence of the wave could have been determined earlier if Alaskan communications had not been cut. One proposal is to set up in the Hawaiian Islands a number of additional seismographs whose records would be fed automatically to Honolulu. Although too close together for high accuracy, they would make it possible to find the epicenter more quickly.

Because some waves have turned out to be small, there have been complaints of "false alarms," and demands for more authentic warnings. But seismology has not advanced to the point of predicting wave heights or how many waves will follow the first. It is safer to assume that every tsunami is a killer.

So far, the Coast Survey's duty has been limited to giving the alarm to public authorities, and answering press queries. The bureau is now studying whether to tie in with the warning system of its sister agency, the Weather Bureau.

Possible moon base shows sick bay and power plant, communication facilities, bunk beds.

Home on the moon

Scientists are now planning a permanent lunar base that will allow men to survive in an environment so hostile that it makes the South Pole look like a picnic spot.

IN THE fast-moving world of aerospace research and development, yesterday's science fiction is tomorrow's history. In perhaps no more than a dozen years, U.S. scientists will be actually living on

the moon for months on end. And right now, engineers at the National Aeronautics and Space Administration and in several leading aerospace firms—Boeing, Douglas, Martin-Marietta, North American Aviation—are quite soberly planning a permanent base that will keep U.S. lunar explorers alive and provide them with a few of the comforts of home. For to say that the lunar environment is hostile to man is one of the understatements of the century; it makes the South Pole, the heights of the Himalayas, the heart of the Sahara look like picnic spots.

In the first place, there will be no air. The moon is an almost perfect vacuum, and men will be able to exist there only in sealed, pressurized enclosures, or in their space suits out of doors.

Water from home

There may be water in underground wells, but getting at it will be a complicated business; the first lunar explorers will have to bring enough to drink, as well as enough to eat, from earth.

As for the temperature up there, it ranges from —250 degrees at midnight of the lunar day to 220 degrees at noon: one more reason for staying inside a space suit, and a serious problem for the base designers, since many of our familiar building materials—concrete, for instance—cannot withstand such extremes of heat and cold.

And to make things even cozier, our lunar explorers and the buildings they live in will be in almost constant danger from meteorites and solar and cosmic radiation.

Then, of course, there is the low gravity problem—a man on the

Reprinted from *News Front*, Management's News Magazine, Dec./Jan. 1964

Temporary buildings, designed to serve as scientific centers, would be connected by passage tubes. Scientific data would be compiled and refined at these centers.

moon will weigh only about one-sixth of what he does on earth, and will have a hard time keeping his feet on the ground. This is a minor problem, though, researchers believe; it will affect the explorers' sense of equilibrium and orientation, but it may give them a few laughs, too.

It will certainly add to the strangeness of life in a world where a "day" takes from two weeks to six months to run its course; where temperatures fall as fast as a shadow passes; where there is no weather, as we know it on earth, no wind, rain, or snow; and where the craggy landscape is colorless.

Moon-gazers are already talking about a site for the base, although the final decision may not be made until the Project Apollo astronauts are back from their pioneer lunar voyage, in 1970 or so. The site will certainly face the earth, so that line-of-sight communications can be maintained. It may be in the west, near the dry "seas" of Tranquility, Fertility, and Nectar, where there are plenty of interesting domes, craters, and highlands to explore; it may be farther east, where Crater Alphonsus looks like a promising source of water.

Since construction costs on the moon will run as high as $100,000 an hour, the base will be a collection of largely prefabricated modules.

These modules, which will make

up living quarters, a dispensary, a maintenance and spares shop, and all the other facilities the little scientific community on the moon will need, will probably be launched from earth by advanced Saturn 5 boosters with payload capacity of about 25,000 pounds.

Laboratory equipment, communications gear, surface vehicles, and probably two complete nuclear reactors for power supply will be launched by Saturns, too, along with fuel, food and water.

The explorers themselves—perhaps 18 or 20 of them at first, physicists, geologists, astronomers, chemists, and technicians—will travel in spacecraft similar to but larger than the three-man Apollo.

The base will almost certainly be underground, with its various units connected by networks of tunnels—not too unlike the lunar city that H. G. Wells imagined in his science fiction classic, "First Men On The Moon."

Above-ground shelters are still being considered, but they would have to have walls about 10 feet thick to protect their inhabitants from radiation, meteoroids, heat and cold. Radiation shielding will be particularly important, because the explorers will have to absorb as much as the human body can tolerate during the voyage to and from earth, 239,000 miles each way.

Units of the underground base might be arranged like spokes of a wheel. The hub would connect different areas to each other and to the communications center.

Science in the news

U.S. space scientists got new hope that we will get to the moon by 1970. An Apollo moon capsule was shot five miles into space. The shot was only a test of the ejection system to save astronauts' lives if the booster develops trouble at or shortly after lift off. But only one technical hitch developed in the complex operation. One of three parachutes didn't open, an eventuality Northrop Company designers anticipated by giving the capsule one more chute than it needed. The test was at White Sands Missile Range, N.M. At Cape Kennedy, the Apollo program progressed another step with the firing of a miniature moonship down the Atlantic. The craft rose 500 miles high and then was accelerated to 25,000 mph, moon return velocity. The test will help to determine the amount of plastic to be put in the heat shield.

Astronomers pondered new mysteries: Why "quasar" (quasi-stellar radio source) 3C-273 has a 13-year pulse-discovered by a comparison of old photographs--and what is it, a star or a galaxy? Why Jupiter is slowing down--discovered by timing the intervals between radio signals from the planet.

The U.S., U.K. and U.S.S.R. agreed to cut back the production of nuclear explosives material. President Johnson had already ordered cuts in U.S. production of enriched uranium and plutonium. Now a new uranium cutback has been ordered. But U.S. production of tritium and lithium deuteride, used in thermonuclear weapons, will continue. As it is, the U.S. arsenal of nuclear weapons is said to total 50,000.

How good are our missiles? The New York Herald Tribune quoted the Air Force as saying that a dozen operational training missions at our 11 Atlas ICBM bases have failed since 1959. Is that bad? Well, the Air Force has called in engineers from General Dynamics Corp., Atlas builders, to help. Usually, it prefers only AF men to launch the "birds."

About 40 percent of U.S. scientists and technicians owe their jobs, at least in part, to Uncle Sam. Anyway, they did in 1962, when the National Science Foundation conducted a study it has just published. Of 215,000 questioned, 97,000 said the Government was helping them. The highest paid: physicists, astronomers.

Three Frenchmen descended five miles to the bottom of the Atlantic off Puerto Rico. They dove into the Puerto Rican Trench in the 70-foot, self-propelled bathyscaph Archimede. U.S. scientists are participating in the series of dives. The three found the trench "full of things," including inch-long fish.

A remarkable topographical feature under the Indian Ocean has been charted by two Columbia University scientists. Dr. Bruce C. Heezen and Marie Tharp correlated soundings by 23 research ships and found an 8,000-foot-high ridge running a distance of 3,600 miles from north to south. It runs along the 90th meridian and is called "the 90-degree Ridge." The Columbia scientists think such ridges are connected with the forces inside the earth that made the continents and oceans.

The supersonic battle is far from over. British and French manufacturers of the Concord have anticipated coming U.S. competition by making the plane bigger, more powerful and able to fly farther than the original Anglo-French plans provided. But the prototype will now probably be ready in 1968, instead of 1967. The U.S. supersonic transport still will be 300 mph faster and carry about twice as many passengers, although it probably won't be ready as soon as the Concord.

Engineers began work on one of the most ambitious archaeological projects of all time. When they're done, members of a West German construction firm will have raised the temples of Abu Simbel, carved out of rock by ancient Egyptians, high above the approaching waters backed up by the Aswan Dam. They will work in the space provided by a coffer dam which they must complete before the expected flood this September. For the moving, they will cut up the temple into 30-ton blocks with electronically-guided saws.

Researchers found new evidence of a connection between viruses and cancer. The Wistar Institute of Philadelphia demonstrated that the virus SV-40, once found in some polio vaccine but later eliminated, can transform cells that grow and multiply in humans. A British doctor isolated a virus from the bone marrow of some patients with leukemias, but none from patients with other diseases. And two Sloan-Kettering Institute doctors found viruses similarly in patients with malignant lymphomas. Still unknown: whether the viruses are responsible for cancer or carry bodies that cause the disease. In the meantime, a National Cancer Institute report indicated that lasers may halt cancer.

The fight against flu and TB also continued. A Dupont pharmacologist said a drug (1-adamantanamine hydrochloride) apparently helped prevent flu and curb it in a person already ill with it. Only once before, it's believed, has a drug helped cure a virus disease. In New York City, health authorities feared a new upsurge of TB and began a program of mass vaccination to strengthen weakened immunity.

QUOTE OF THE MONTH: "The scientist must meet his fellow men at least half way in the process of communication, by translating his professional jargon and by exposing the intuitive basis of his work by permitting and encouraging other men to take at least vicarious satisfaction in scientific discoveries." --ROBERT JASTROW, Director of the Goddard Institute of Space Studies of NASA.

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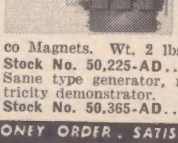

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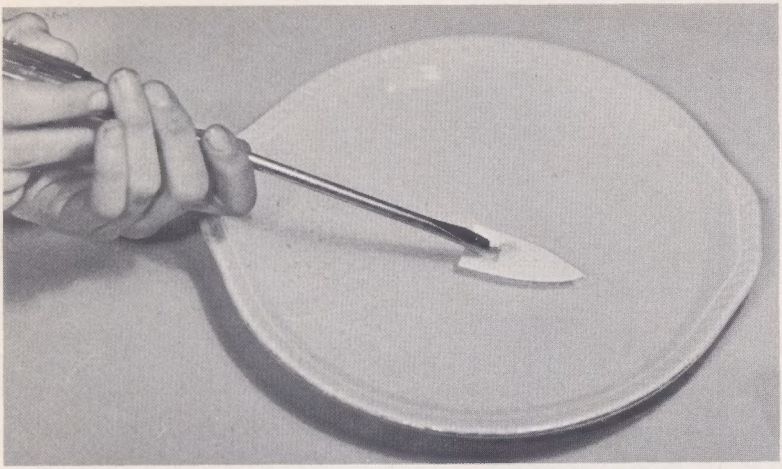


Out with the tide

by Charles Vivian

You will need: Card, scissors, pencil, large plate or bowl, water, screwdriver, detergent.

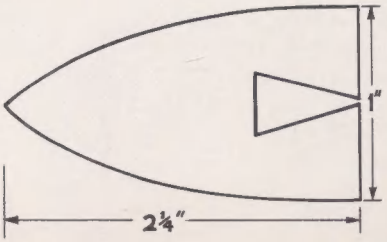
First, draw a simple boat shape on a piece of card, to the dimensions indicated in the diagram. Cut this out carefully, including the triangle.

Fill a large plate with water and launch your boat to make sure it floats well.

Now take a little detergent powder on the blade of a screwdriver or the end of a knife, and drop it carefully into the small, triangular opening that you have cut in the stern of your boat.

Within a few seconds the boat will be traveling forward through the water, as the detergent breaks down the surface tension and tries to expand through the narrow opening in the rear of the model.

Try repeating this experiment, with a drop of oil from an oil can, in place of the detergent, or by floating a small piece of camphor at the rear of the model boat. Both oil and camphor have an effect on surface tension, as you will notice.



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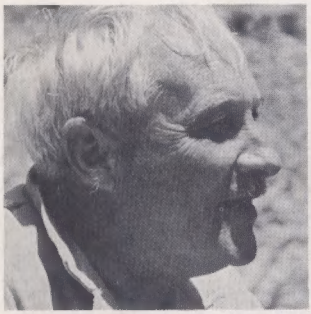

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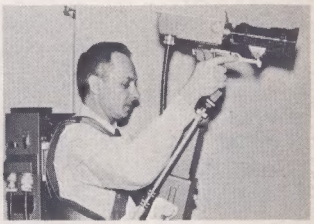
Dr. Louis Leakey's fossil finds may revolutionize our idea of man's evolution. See story starting on page 65.

Diving beneath the ocean in an atomic submarine is more like flying than sailing. Find out how it feels on page 48.

An almost unknown government agency saved scores of lives after the Alaskan earthquake. The details begin on page 83.

This month Hugh Downs calls a time out to talk about how to tell time. Downs' column begins on page 60.

The great sport of SCUBA diving in America began with this man. His story starts on page 14.



This device will help you get a close-up of the national conventions. For an explanation of what it is see the inside front cover.

Learn how to discover if you are being bugged on page 40.